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Pan-Pacific Science Congress

Australia, 1923

HANDBOOK for

MELBOURNE MEETING

13th to 22nd August, 1923

By Authority:
Albert J. Mullett, Government Printer, Melbourne.

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Pan-Pacific Science Congress

(AUSTRALIA), 1923

HELD UNDER THE AUSPICES OF

The Australian National Research Council

AND THROUGH THE GENEROSITY OF

The Commonwealth and State Governments

HANDBOOK

for

Melbourne Meeting

13th to 22nd August, 1923

at the University of Melbourne

Programme of Arrangements

with

Particulars of Excursions,

Maps, and Plans.

By Authority:

Albert J. Mullett, Government Printer, Melbourne.

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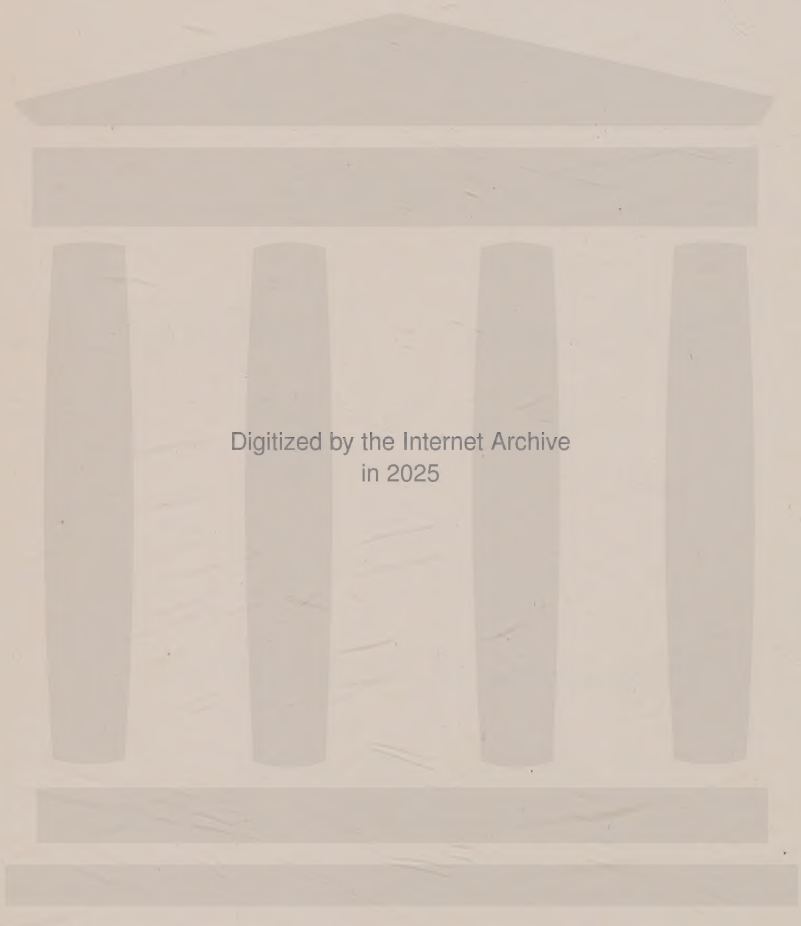

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— PAN-PACIFIC CONGRESS AUSTRALIA 1923 —

Drawn by Home & Territories Department Lands & Surveys Branch June 1923

PAN-PACIFIC SCIENCE CONGRESS

(AUSTRALIA), 1923.

HANDBOOK FOR MELBOURNE MEETING.

I.—PATRONS, PRESIDENT, VICE-PRESIDENTS, AND OFFICERS OF CONGRESS.

PATRONS.

His Excellency the Right Honorable Henry William Baron Forster, P.C., G.C.M.G., D.L., Governor-General of the Commonwealth of Australia.

His Excellency Sir Walter Davidson, K.C.M.G., Governor of New South Wales.

His Excellency the Honorable Sir William Irvine, K.C.M.G., M.A., LL.M., LL.D., Lieutenant-Governor and Chief Justice of Victoria.

His Excellency the Right Honorable Sir Matthew Nathan, P.C., G.C.M.G., Governor of Queensland.

His Excellency Sir Tom Bridges, K.C.M.G., C.B., Governor of South Australia.

His Excellency Sir F. Newdigate Newdegate, K.C.M.G., Governor of West Australia.

His Excellency Sir Herbert Nicholls (Administrator), Governor of Tasmania.

PRESIDENT.

Professor Sir David Orme Masson, K.B.E., M.A., D.Sc., F.R.S., F.I.C., President of the Australian National Research Council.

VICE-PRESIDENTS.

The Honorable Sir William Portus Cullen, K.C.M.G., M.A., LL.D., Lieutenant-Governor and Chief Justice of New South Wales, and Chancellor of the University of Sydney.

The Right Honorable Stanley Melbourne Bruce, P.C., M.C., M.P., Prime Minister of the Commonwealth of Australia.

The Right Honorable William M. Hughes, P.C., K.C., M.P., formerly Prime Minister of the Commonwealth of Australia.

Vice-Presidents—*continued.*

The Honorable E. G. Theodore, M.L.A., Premier of Queensland.

The Honorable Sir Henry N. Barwell, K.C.M.G., M.H.A., LL.B., Premier of South Australia.

The Honorable Sir James Mitchell, K.C.M.G., M.L.A., Premier of West Australia.

The Honorable J. B. Hayes, C.M.G., Premier of Tasmania.

Sir John Monash, G.C.M.G., K.C.B., V.D., B.A., D.Eng., LL.D., Chairman, Victorian Electricity Commission.

Professor Sir Baldwin Spencer, K.C.M.G., M.A., D.Sc., Litt.D., F.R.S., Vice-President of the Australian National Research Council.

Professor Sir T. W. Edgeworth David, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S., Past President and Vice-President of the Australian National Research Council.

Sir Robert Gibson, K.B.E., President, Victorian Chamber of Manufactures.

Sir John H. MacFarland, M.A., LL.D., Chancellor of the University of Melbourne.

Sir George H. Knibbs, C.M.G., Hon. F.S.S., Director of the Commonwealth Institute of Science and Industry, and Vice-President of the Australian National Research Council.

The Right Honorable the Lord Mayor of Melbourne, Councillor Sir John W. Swanson.

The Right Honorable the Lord Mayor of Sydney, Alderman David Gilpin.

Professor H. E. Gregory, Yale University and Director Bishop Museum, Honolulu, Ex-President of the Pan-Pacific Science Congress, 1920.

J. H. Maiden, I.S.O., F.R.S., F.L.S., Vice-President of the Australian National Research Council.

W. H. Swanton, President, Melbourne Chamber of Commerce.

GENERAL SECRETARIES.

R. H. Cambage, F.L.S., Royal Society, Elizabeth-street, Sydney.

Assoc. Prof. A. C. D. Rivett, M.A., D.Sc., The University, Melbourne. (Tel. Nos. C.283 and C.1554.)

E. C. Andrews, B.A., F.G.S., Mines Department, Sydney.

G. Lightfoot, M.A., Commonwealth Institute of Science and Industry, Melbourne. (Tel. Nos. J.4171 and Windsor 6160.)

CHAIRMEN OF STATE PAN-PACIFIC COMMITTEES.

New South Wales.—Professor Sir T. W. Edgeworth David, K.B.E., C.M.G., F.R.S., &c., Sydney University.

Victoria.—Professor W. E. Agar, M.A., D.Sc., F.R.S., Melbourne University.

MEMBERS OF THE EXECUTIVE COMMITTEE, AUSTRALIAN NATIONAL RESEARCH COUNCIL.

E. C. Andrews, B.A., F.G.S.
Professor H. G. Chapman, M.D., B.S.
Professor K. Grant, M.Sc.
C. Hedley, F.L.S.
Loftus Hills, M.B.E., M.Sc.
Professor Sir Thomas R. Lyle, C.B.E., M.A., D.Sc., F.R.S.
Professor Sir Douglas Mawson, O.B.E., B.E., D.Sc., F.R.S.
Professor H. J. Priestley, M.A.
Professor E. W. Skeats, D.Sc., F.G.S.
Professor B. D. Steele, D.Sc., F.R.S., F.I.C.
W. E. Wainwright, B.Sc.
Professor N. T. M. Wilsmore, D.Sc., F.I.C.

SECTIONAL CHAIRMEN.

Section.	Melbourne.	Sydney.
I. Agriculture ..	Dr. Elwood Mead, D.Eng., University of California	Prof. E. C. Stakman, University of Minnesota
II. Anthropology and Ethnology	Dr. A. C. Haddon, M.A., D.Sc., F.R.S., Cambridge University	Dr. W. J. Perry, B.O., London University
III. Botany ..	Prof. W. L. Jepson, University College, California	Prof. S. Ikeno, Tokyo University
IV. Entomology ..	Dr. R. J. Tillyard, Cawthron Inst., N.Z.	Dr. G. A. K. Marshall, C.M.G., F.R.S., Imperial Bureau of Entomology, London
V. Forestry ..	..	..
VIa. Geodesy and Geophysics VIb. Radio Teleg., &c.	Col. Sir Gerald Lenox-Conyngham, R.E., F.R.S., Cambridge University	Prof. F. Omori, Tokyo University
VII. Geography and Oceanography	Prof. N. Yamasaki, Tokyo University	Dr. E. Huntington, Yale University
VIII. Geology ..	Prof. H. A. Brouwer, University, Delft	Prof. H. E. Gregory, Bishop Museum, Honolulu
IX. Hygiene ..	Dr. R. R. Sayers, Bureau of Mines, Washington	Dr. C. J. Martin, M.D., D.Sc., F.R.S., Lister Inst., London
X. Veterinary Science	Prof. Nitta, Tokyo University	Dr. C. Bubberman, Veterinary Lab., Buitenzorg
XI. Zoology ..	Prof. W. E. Ritter, Scripps Inst., California	Prof. W. E. Pilsbry, Philadelphia Academy of Sciences

SECTIONAL SECRETARIES.

Section.	Melbourne.	Sydney.
I. Agriculture ..	A. E. V. Richardson, M.A., B.Sc., Dept. of Agric., Melbourne	Prof. R. D. Watt, M.A., B.Sc., University, Sydney
II. Anthropology and Ethnology	E. L. Piesse, B.Sc., LL.B., Pacific Branch, Prime Minister's Dept., Melbourne	S. A. Smith, M.B., Ch.M., 149 Macquarie - street, Sydney, and Prof. John I. Hunter, M.D., M.Ch., University, Sydney
III. Botany ..	R. B. Patton, M.Sc., M.F., University, Melbourne	Prof. A. A. Lawson, D.Sc., F.R.S.E., F.L.S., University, Sydney
IV. Entomology ..	J. A. Kershaw, F.E.S., National Museum, Melbourne	W. W. Froggatt, F.L.S., Dept. Agriculture, Sydney
V. Forestry ..	A. V. Galbraith, Forests Commission, Melbourne	R. Dalrymple Hay, Chairman, Forest Dept., Sydney
VIa. Geodesy and Geophysics	E. F. J. Love, M.A., D.Sc., F.R.A.S., University, Melbourne	Rev. E. F. Pigot, S.J., B.A., M.B., Riverview, Sydney, and D. T. Sawkins, M.A., Dept. Labour and Industry, Sydney
VIb. Radio Teleg., &c.		Prof. W. E. Cooke, M.A., F.R.A.S., The Observatory, Sydney, and S. Basil Cooke, The Observatory, Sydney
VII. Geography and Oceanography	Capt. J. K. Davis, Dept. Navigation, Melbourne	C. A. Sussmilch, F.G.S., Tech. College, Newcastle, and Prof. T. Griffith Taylor, D.Sc., University, Sydney
VIII. Geology ..	Prof. E. W. Skeats, D.Sc., F.G.S., University, Melbourne	Assoc. Prof. L. A. Cotton, M.A., D.Sc., University, Sydney
IX. Hygiene ..	J. H. L. Cumpston, M.D., B.S., D.P.H., F.San.I., Director-General, Commonwealth Dept. of Public Health, Melbourne	Prof. H. G. Chapman, M.D., B.S., University, Sydney
X. Veterinary Science	Prof. H. A. Woodruff, M.R.C.V.S., M.R.C.S., L.R.C.P., University, Melbourne	Prof. J. D. Stewart, B.V.Sc., M.R.C.V.S., University, Sydney
XI. Zoology ..	Prof. W. E. Agar, M.A., D.Sc., F.R.S., University, Melbourne	C. Hedley, F.L.S., Aust. Museum, Sydney

II.—OVERSEAS MEMBERS OF CONGRESS.

GREAT BRITAIN.

BUTLER, Dr. E. J., C.I.E., Director Imperial Bureau of Mycology, Kew, and representing British Government .. *Agriculture and Botany*

DUFFIELD, Professor W. G., present address Dundrennan, Sea Wall, Glenelg. South Australia .. .. *Geodesy*

EWART, Dr. J. Cossar, F.R.S., Professor of Natural History, University of Edinburgh .. .. *Zoology*

HADDON, Dr. A. C., M.A., Sc.D., F.R.S., Cambridge, England, and representing Royal Society of London and Cambridge University *Anthropology and Ethnology*

IREDALE, T., Ealing, London, Ornithologist .. .. .. *Zoology*

LENOX-CONYNGHAM, Col. Sir Gerald, R.E., F.R.S., Cambridge University, representing British Government, Royal Society of London and Cambridge University .. .. *Geodesy*

MARRIOTT, H. F., M.Inst.M.M., Imperial Mineral Resources Bureau, representing British Government, Inst. of Mining Engineers, and Inst. of Mining and Metallurgy .. .. *Geology*

MARSHALL, Dr. G. A. K., C.M.G., F.R.S., Director, Imperial Bureau of Entomology, representing British Government and Royal Society of London *Entomology*

MARTIN, Dr. C. J., M.D., D.Sc., F.R.S., Chelsea Gardens, Chelsea Bridge-road, London, and representing Royal Society of London and Lister Institute .. .. *Hygiene*

PERRY, Dr. W. J., B.O., University College, London University *Anthropology and Ethnology*

PITCHFORD, Dr. Watkins, Miners' Phthisis Medical Bureau, Johannesburg *Hygiene*

UNITED STATES AMERICA.

BABCOCK, Dr. E. B., University of California, Berkeley, Cal. .. *Agriculture*

BENFIELD, B., Ph.B., M.Am.Soc.C.E., representing Astronomical Society of the Pacific, San Francisco, Cal. .. .. *Physics*

BERRY, Dr. E. W., Johns Hopkins University, Baltimore, Maine *Geology*

BROOKS, Col. Dr. A. H., U.S. Geological Survey, Washington, representing United States of America, Geological Society of America, and Washington Academy of Sciences .. .. *Geology*

BUTLER, B. S., Calumet and Hecla Mining Co., Michigan, representing Geological Society of America .. .. *Geology*

CRAMPTON, Professor H. E., Ph.D., Columbia University, New York, also representing the University .. .. *Zoology*

Overseas Members of Congress—*continued.*

United States America—*continued.*

FENNEMAN, Dr. N. M., The University, Cincinnatti, Ohio, Professor of Geography, representing U.S.A. National Research Council and Geological Society of America .. .. *Geography*

HOBBS, Professor W. H., University of Michigan, Ann Arbor, Mich., and representing the University and Geological Society of America *Physics*

HOVEY, Dr. E. Otis, American Museum of Natural History, New York, representing Museum, the Geological Society of America and the New York Academy of Sciences .. .. *Geology*

HUNTINGTON, Dr. Ellsworth, Yale University, and representative *Geography and Oceanography*

JEPSON, Professor W. L., University College, California .. .. *Botany*

MEAD, Dr. Elwood, D.Eng., Professor of Rural Institutions, representing University of California; present address care of Lands Department, Sydney .. .. *Agriculture*

MOORE, Alfred F., Director Smithsonian Solar Observing Station, Arizona, representing United States of America and Smithsonian Institute *Physics*

PILSBRY, Professor W. E., Philadelphia Academy of Sciences .. *Zoology*

RITTER, Professor W. E., Director Scripps Institute, La Jolla, Cal., representing University of California .. .. *Zoology*

SAYERS, Dr. R. R., representing United States of America and Bureau of Mines, Washington .. .. *Hygiene*

STAKMAN, Professor E. C., University of Minnesota .. .. *Agriculture*

VAUGHAN, Dr. T. W., U.S., Geological Survey, Washington, D.C., representing United States of America and Geological Society of America *Geology*

WAIT, Dr. G. R., present address Magnetic Observatory, Watheroo, Western Australia, representing Carnegie Institution, Washington .. *Physics*

CANADA.

BROCK, Dr. R. W., F.R.S.C., Professor of Geology and Dean of the Faculty of Applied Science, University of British Columbia, and representing the University and Department of Mines, Canada .. *Geology*

FRASER, Dr. C. M., F.R.S.C., University of British Columbia, representing Canadian Department of Fisheries and Research Council of Canada *Zoology*

MCMURRICH, Professor J. P., F.R.S.C., University of Toronto, representing University and the Research Council of Canada .. .. *Anthropology*

Overseas Members of Congress—*continued.*

HONOLULU.

Cooke, Dr. C. Montague, Bishop Museum, and representative .. *Zoology*
Ehrhorn, Dr. E. M., Board of Agriculture and Forestry .. *Entomology*
Ford, A. H., Director of Pan-Pacific Union, Honolulu
Fullaway, D. T., U.S. Agricultural Experiment Station .. *Entomology*
Gregory, Professor H. E., Yale University and Director Bishop Museum, Honolulu, representing United States of America, Yale University, Geological Society of America, and Bernice P. Bishop Museum *Geology*
Jaggar, Jr., Dr. T. A., Director, Hawaiian Volcano Observatory *Physics*
Romberg, Dr. Arnold, representing University of Hawaii .. *Physics*
Swezey, Dr. O. H., Bishop Museum .. .. .. *Entomology*
Wilder, Gerrit P., Bernice P. Bishop Museum, and representative *Botany*

NEW ZEALAND.

Armstrong, Dr. J. S., Western Samoa Administration, representing N.Z. Government .. .. *Anthropology and Ethnology*
Benson, Professor W. N., D.Sc., Otago University, Dunedin, N.Z., and representative .. .. *Geology*
Brown, Professor J. Macmillan Holmbank, Cashmere Hills, Christchurch, representing University of New Zealand (Chancellor)
Buck, Dr. P. H., D.S.O., Government Medical Officer to Maoris, Wellington, representing N.Z. Government and Polynesian Society of N.Z. *Anthropology and Ethnology*
Cotton, Dr. C. A., University College, Wellington .. .. *Geology*
Easterfield, Dr. T. H., delegate, Cawthron Trust, Nelson (Director) *Agriculture*
Kirk, Professor H. B., Victoria University College, Wellington.. *Zoology*
Marshall, Dr. P., care of Dr. Dudley, Lower Hutt, Wellington, and representing N.Z. University, Dunedin .. .. *Geology*
Morgan, P. G., Government Geologist, Wellington, representing N.Z. Government .. .. *Geology*
Skinner, H. D., Dunedin, representing Polynesian Society, N.Z., and Otago University .. .. *Anthropology and Ethnology*
Speight, Professor R., Christchurch, representing Canterbury College, Christchurch, N.Z. .. .. *Geology*
Thomson, J. A., M.A., B.Sc., Dominion Museum, Wellington *Geology*
Tillyard, Dr. R. J., Cawthron Institute, Nelson, N.Z. .. *Entomology*

JAPAN AND FORMOSA.

Ikeno, Dr. S., Professor of Botany, Tokyo Imperial University *Agriculture*
Kishinouye, Professor K., Tokyo Imperial University .. *Zoology*
Kondo, Dr. M., Director Ohara Agricultural Station, Kurashiki, Okayama Prefecture .. .. *Agriculture*

Overseas Members of Congress—*continued.*

Japan and Formosa—*continued.*

NITTA, Dr. N., Imperial University, Komaba, Tokyo .. *Veterinary Science*
OGURA, Dr. S., Hydrographic Office, Imperial Japanese Navy .. *Geodesy*
OMORI, Dr. F., Professor of Seismology, Imperial University, Tokyo *Physics*
OSHIMA, Dr. M., Inst. of Science, Liahoku, Formosa .. .. *Entomology*
SAKURAI, Dr. Joji, Education Department, Vice-President, National Research Council of Japan
SHINJO, Dr. S., Professor of Astronomy, Kyoto University .. *Geodesy*
TODA, Dr. S., Professor of Hygiene, Kyoto, Imperial University *Hygiene*
YAMASAKI, Dr. N., Professor of Geography, Imperial University, Tokyo *Geography and Oceanography*

PHILIPPINES.

APOSTOL, Hon. S., Under-Secretary for Agriculture, representing Philippine Government .. .. *Agriculture*
ELICANO, Victoriano, Bureau of Science, Manila, and representing Philippine Government and Bureau of Science .. .. .. *Geology*
GUERRERO, Leon M., Phar.D., Economic Botanist, Philippine Bureau of Science *Botany*
MASO, Rev. Miguel S., Philippine Weather Bureau, Manila .. .. *Geodesy*
MERRILL, Dr. Elmer D., Director, Bureau of Science, Manila, and representing Philippine Government and Bureau of Science .. .. *Botany*
SELGA, Rev. M., Assistant Director, Weather Bureau, representing Philippine Government .. .. *Geodesy*
SMITH, Professor Warren D., Oregon University and Bureau of Science, and representing Oregon University .. .. .. *Geology*
YOUNGBERG, Dr. S., Bureau of Agriculture, representing Philippine Government *Veterinary Science*

NETHERLANDS AND DUTCH EAST INDIA GOVERNMENT.

BRAAK, Dr. C., Director Royal Magnetic and Meterologic Observatory, representing Dutch East India Government and Natuurwetenschappelyk Congress, Buitenzorg .. .. *Physics*
BROUWER, Dr. H. A., University, Delft, Holland, and representing Kon. Ned. Aardrykskundig Genootschap, Amsterdam, and Konnicklijke Akademie van Wetenschappen .. .. *Geology*
BUBBERMAN, Dr. C., Director, Veterinary Laboratory, Buitenzorg *Veterinary Science*
LEEUWEN, Dr. W. H. Docters van, Director Botanical Garden, Buitenzorg, representing Dutch East India Government and Koninklijke Natuurkundige Vereeniging, Weltevreden .. .. .. *Botany*

Overseas Members of Congress—*continued.*

Netherlands and Dutch East India Government—*continued.*

ROMBURGH, Dr. P. van, Holland, representing Netherlands Government, Konnicklijke Akademie van Wetenschappen, and Koloniaal Instituut

VALKENBURG, Dr. S. van, Topographical Service, Batavia, representing Indisch Comite voor Wetenschappelyke Onderzoekingen, Weltevreden *Geography and Oceanography.*

BURMA.

HUNTER, Dr. Matthew, representing University College, Rangoon

BRITISH MALAYA.

EATON, Major B. J., O.B.E., Kuala Lumpur, Federated Malay States, representing Straits Settlements and Federated Malay States .. *Agriculture*

STEAD, D. G., lately residing in British Malaya, now at Sydney, representing Straits Settlements and Federated Malay States (Fisheries) *Zoology*

TAHITI.

YOUNG, James L., Polynesian Society, Tahiti *Anthropology and Ethnology*

PAPUA.

BRYCE, G., B.Sc., Director of Agriculture, Papua .. .. *Agriculture*

STANLEY, E. R., Government Geologist, Samarai, Papua .. *Geology*

VEITCH, R., Colonial Sugar Co., Lautoka .. .. *Entomology*

HONG KONG.

Principal Medical Officer .. .. *Hygiene*

III.—OBJECTS AND ORGANIZATION OF THE PAN-PACIFIC SCIENCE CONGRESSES.

The main object of the Pan-Pacific Science Congress 1923, like that of the first Congress which was held in Honolulu in 1920, are twofold—(1) to discuss and promote concerted action in regard to scientific problems specially affecting the industrial progress, commercial interests, health, and well-being of Pacific peoples; and (2) to strengthen the bonds of peace among all the peoples around the Pacific by means of promoting a feeling of brotherhood among scientists and the maintenance of harmonious relations between the peoples of the Pacific regions.

So far as Australia is concerned the idea of promoting joint discussions on Pan-Pacific problems originated during the visit to Australia of the British Association for the Advancement of Science in 1914. At about the same time a Conference was held in Honolulu at which representatives of a number of Pacific peoples were present, and it was then decided to inaugurate a movement looking toward a closer union of effort by and among the peoples of Pacific lands to join hands around the ocean, as it were, in an endeavour to advance the interests of all Pacific communities.

The ideas brought forward at the British Association meeting in Australia in 1914 were more or less of a nebulous nature. The idea was, however, carried one step further by Professor W. M. Davis, of Harvard University, who examined the coral reefs of the Pacific in 1914, and who was a delegate to the British Association meeting in that year. Professor Davis arranged a symposium on Pacific exploration for the Annual Meeting of the American National Academy of Science in 1916. The visit of Professor H. E. Gregory, of Yale University, to Australia and New Zealand in 1916 gave a further impetus to the movement. In 1918 a Conference on International Relations in which scientific problems received attention formed part of the programme of the Jubilee Anniversary of the University of California. At the close of this meeting the representatives from the various countries of the Pacific expressed a wish to call another Conference to deal with Pacific problems soon after the close of the war. The country apparently favoured for this meeting was Japan. In 1919 the American Association for the Advancement of Science included papers on Exploration in the North Pacific. A Committee on Pacific Exploration had been appointed by the American National Academy of Science, but in 1920 this Committee was handed over to the American National Research Council with the title of "Committee on Pacific Investigations."

At this stage it was coming to be seen more and more plainly that a Conference of interested scientists in the United States, Canada, China, Japan, Hawaii, the Philippines, New Zealand, Dutch East Indies, and Australia was necessary to promote and co-ordinate the study of outstanding problems of the Pacific peoples.

While plans for such a Congress were being discussed a way happily opened for holding the meeting at Honolulu in 1920, under the auspices of the Pan-Pacific Union, an organization which had been established, among other things, for the purpose of bringing all nations and peoples about the Pacific into closer friendly and commercial contact and relationship. In April, 1919, the Legislature of the Territory of Hawaii appropriated funds to be used by the Pan-Pacific Union, and for defraying the expenses of a Pan-Pacific Commercial and Educational Conference during 1920 or 1921, and the Governor of Hawaii placed the organization of the proposed Conference in charge of a Committee composed of representative citizens in Honolulu. In order to comply with the conditions of the appropriation by the Hawaiian Legislature the Congress was given the official title of the " First Pan-Pacific Scientific Conference of the Commercial and Educational Congress." At that meeting the delegates from Australia were E. C. Andrews, B.A., F.G.S., Professor H. C. Richards, D.Sc., C. Hedley, F.L.S., Assoc. Prof. L. A. Cotton, M.A., D.Sc., Prof. F. Wood-Jones, M.B., D.Sc., &c., and C. A. Sussmilch, F.G.S. The purpose of this Conference was to outline the scientific problems of the Pacific Ocean region, and suggest methods for their solution. The Conference took stock of the existing state of knowledge of the Pacific area, its geography and geology, its plants and animals, and the races of men which inhabit it, and proceeding from this comprehensive view it dealt in a broad manner with the outlines of schemes for future Congresses and research.

Although the Conference was held under the auspices of the Pan-Pacific Union, its scientific discussions were conducted solely under the direction of the National Research Council of America through its Committee on Pacific Investigations. The Honolulu meeting was thus a child of the American National Research Council, supported by the funds allocated to the Pan-Pacific Union by the Territory of Hawaii.

At the close of the Honolulu meeting a Committee was formed consisting of one delegate from each of the seven countries represented at the Conference, namely, the United States, Canada, Japan, the Philippines, Hawaii, New Zealand, and Australia. The main object of this Committee was to make arrangements for subsequent meetings of the Conference. The Committee considered that the objects of the Conference could be forwarded best by holding triennial Congresses at various important centres within the Pacific, and that these Congresses should be held under the auspices of National Science Institutions such as the various National Research Councils. Japan, the United States, and Hawaii were anxious to hold meetings in their respective countries, but it was decided that New Zealand and Australia should first have the opportunity of acting as host for the 1923 meeting. The Dominion of New Zealand found itself unable to invite the Congress, and arrangements were accordingly made for it to be held in Australia, the Commonwealth Government and the Governments of New South Wales and Victoria having generously promised financial support as well as other assistance.

The matter of making the necessary arrangements for the Congress wa placed in the hands of the National Research Council of Australia, which is a branch of the International Research Council formed after the war and embracing all the Allied and neutral nations. The Australian National Research Council appointed a Pan-Pacific Science Congress Committee to organize the scientific programme of the Congress, while State Committees in New South Wales and in Victoria were formed to make arrangements for the meeting of the Congress in Sydney and Melbourne respectively.

Invitations to be represented at the Australian Congress were sent to the Governments of the countries specified below. In addition, invitations were also sent to a number of Scientific Institutions, Universities, and individuals: —

1. Bolivia.
2. Canada.
3. Chile.
4. China.
5. Columbia.
6. Costa Rica.
7. Ecuador.
8. France (New Caledonia, Tahiti, the New Hebrides, French Indo-China, &c.).
9. Great Britain (Fiji, Tonga, Samoa, New Hebrides, Malay Straits, &c.).
10. Guatemala.
11. Honduras.
12. Japan and Mandated Territories in the Pacific.
13. Mexico.
14. Netherlands (Java and Netherlands Indies generally and Dutch New Guinea).
15. New Zealand.
16. Nicaragua.
17. Panama.
18. Peru.
19. Siam.
20. United States of America (Alaska, Hawaii, Philippines, Samoa, &c.).

The Congress will open at Melbourne on Monday, the 13th August, 1923, and terminate there on Wednesday, the 22nd August, when members will leave for Sydney. It will be continued at Sydney on Thursday, the 23rd August and will terminate on Monday, the 3rd September. By the courtesy of the University Council arrangements have been made for the Melbourne meeting of the Congress to be held at the University.

IV.—VICTORIA AND ITS METROPOLIS.—ORIGIN AND DEVELOPMENT.

A. VICTORIA.

1. Foundation of Colony.—There is little doubt that the first discovery by white man of any part of Victoria was that made in 1770 by Captain Cook in the *Endeavour*, when Point Hicks, believed to be the point now called Cape Everard, was sighted and named. Nothing further was learned of the coast of Victoria until 1798, in which year Bass entered Western Port. Later in the same year, what is now known as Bass Strait was proved by Flinders to be a strait.

Towards the end of 1803 an attempt to colonize Port Phillip was made by Colonel Collins, who founded at Sorrento a convict settlement, which was, however, abandoned early in the following year. It was from this settlement that Buckley escaped to a life with the natives extending over 32 years.

For twenty years the colony of Victoria, as the country was named later, was untrodden by foot of any other white man, until in 1824 Hume and Hovell, who had led an expedition overland from Lake George in New South Wales, camped on the site of the present city of Geelong.

In 1826 an attempt was made to colonize Western Port by Captain Wright in charge of a party of convicts, but this establishment was withdrawn early in 1828.

A permanent but isolated settlement was founded in 1834 at Portland by Edward Henty, who with his brothers established themselves there with flocks, farm servants, and agricultural implements, and two years later were found there by Major (afterwards Sir Thomas) Mitchell, the explorer.

The genuine colonization of the Port Phillip district, as Victoria was then called, was effected in 1835, by two parties operating from Van Diemen's Land—the one led by John Batman, who made with the natives a treaty, afterwards disallowed by the Government, for 600,000 acres of land, the other sent some three months later by John Fawkner. The latter party sailed up the Yarra and founded Melbourne on the site previously selected by Batman. Fawkner himself followed shortly after.

The first years of settlement might be described as the pastoral era; large tracts of land being taken up and stocked, principally with sheep.

The first resident magistrate of the Port Phillip District was William Lonsdale, who was sent from Sydney in 1836. In 1839 the District was placed under the charge of a Superintendent, and the first person to fill that *rôle* was Charles La Trobe.

2. Separation from New South Wales.—The separation of Victoria from New South Wales was mooted in the Legislative Council of New South Wales in 1844, but the proposal was negatived. In the same year a petition praying for separation was sent to England, and a favorable reply was received in 1846. In 1851 Victoria was proclaimed a separate colony and La Trobe was appointed Lieutenant-Governor. The area of the colony thus separated from New South Wales was 87,884 square miles, or 56,245,760 acres. In the previous year the Port Phillip District had a revenue of £230,000, its exports amounted to £760,000, and its population was over 76,000.

3. Constitution.—Until 1842 the Port Phillip District was not represented in the Legislative Council of New South Wales, but in that year six representatives were elected members thereof.

The Victorian Electoral Act of 1851 provided for a Legislative Council of 30 members, of whom 10 were to be nominated by the Crown and 20 elected from 16 electoral districts. In 1855 responsible government was granted, and the bicameral and cabinet systems were introduced; in the following year members were elected, and the new Parliament, comprising a Legislative Council and a Legislative Assembly, met for the first time on the 21st November, 1856. The Legislative Council consisted of 30 members and the Legislative Assembly of 60 members. The qualifications for membership and for electors for both Houses have been amended from time to time, and the number of members increased. At present any male British subject over 30 years of age and possessed of freehold estate of the clear annual value of £50 is eligible for election to the Legislative Council, while any male adult British person who has been resident in Victoria for over two years is eligible for election to the Legislative Assembly. An elector for the Council must possess a certain amount of property or certain other qualifications, while for the Assembly practically every British subject over 21 years of age resident in Victoria for upwards of six months has a vote. The franchise was extended to females in 1908.

On the 1st of January, 1901, the federation of the Australian colonies was effected, and the imposition of Customs and Excise duties and the control of the post and telegraph systems and of the Defence Department were handed over to the Commonwealth Government. In consequence of the functions of the colony being so curtailed, a reduction was made in 1903 in the number of members to 34 for the Council and 65 for the Assembly, and there has been no change in those numbers up to the present date. Payment of members of the Assembly was introduced in 1870, and is fixed at present at £500 per annum. Members of the Council were paid at the rate of £300 per annum from 1870 to 1880, when such payments were discontinued. In 1922, however, an Act was passed under which they are now paid £200 per annum.

4. Gold Mining.—The year 1851 was the date of the discoveries of gold in Victoria, and the population of the colony increased by leaps and bounds, reaching nearly 365,000 in 1855, and over half-a-million in 1860. The value of the gold raised in Victoria from 1852 to 1860 inclusive was upwards of £95,000,000, the total value raised to the present date being upwards of £300,000,000.

In connexion with the gold diggings, mention may be made of the Eureka Stockade Riots and their cause. One of the first acts of the Legislative Council was the imposition of a licence-fee of £1 10s. per month, exacted from every person searching for gold, and available only within half-a-mile of the police head-quarters whence it had been issued. This licence had to be produced by a gold seeker on the demand of any police officer. These demands proved very irksome, and "digger-hunting," as it was called, was frequently carried out with unnecessary harshness. This led to bad feeling between the miners and the Government, and culminated in some of the miners organizing themselves in November, 1854, for armed defence behind a stockade in Ballarat, known in later days as the Eureka Stockade. The stockade was attacked by the military and carried, about 30 miners being killed and 125 taken prisoners. The military losses comprised an officer and four men killed and a dozen men wounded. The prisoners who were placed on trial were all acquitted, and the causes which led to the outbreak were removed.

5. Burke and Wills' Expedition.—The year 1857 saw the start from Melbourne of Burke and Wills on an exploring expedition to the interior of Australia. The venture, however, proved fatal to both of the leaders, only one survivor of the party being found alive by relief parties sent to ascertain their fate.

6. Position of Colony in 1860.—By the end of 1860 the colony of Victoria may be described as settled chiefly by pastoralists, although some progress had been made in agriculture. At this date the population was over half-a-million, and for that year the production of wool exceeded 22 million pounds. A little over 407,000 acres of land were under cultivation; the yield of wheat was nearly two million bushels, and of oats over two and a half millions; and the number of sheep was over five and three-quarter millions; while the output of gold was still high—nearly nine million pounds worth having been raised during the year.

7. Population.—The first census of Victoria was taken in 1838 when the population was only 3,511, with a great preponderance of males over females.

The population, however, grew rapidly, and the following table gives the estimated numbers at the end of the succeeding decades, and also at the end of last year :—

ESTIMATED POPULATION, 1850 to 1922.

Year.	Estimated Population at 31st December.		
	Males.	Females.	Total.
1850	45,495	30,667	76,162
1860	328,251	209,596	537,847
1870	398,755	327,844	726,599
1880	451,456	408,611	860,067
1890	596,064	537,202	1,133,266
1900	602,487	594,719	1,197,206
1910	652,285	655,826	1,308,111
1920	754,756	765,079	1,519,835
1922	788,531	801,981	1,590,512

It will be noted that the number of females now exceeds the number of males.

8. FINANCE.—The revenue of the State of Victoria is now derived chiefly from contributions from the Federal Government, from taxation (income, probate, land, stamp, &c.), from public works and services (including railways), and from land sales and rents. Prior to Federation, a large revenue was derived from customs and excise duties which were taken over by the Commonwealth in 1901, a *per capita* payment to the States being now made in lieu thereof. The State revenue for the financial year 1921 22 was £20,357,733, or £13 2s. 6d. per head of the population, of which £3,791,174 came from taxation and £11,918,786 from public works and services.

The largest items of expenditure are interest on the public debt, working expenses of railways and tramways, and education. In the financial year 1921–22 the expenditure was £20,297,279, of which £4,982,389 went in interest on the public debt, £8,117,070 on the working expenses of the railways and tramways, and £1,940,450 on education.

The above figures are exclusive of loan expenditure, which in 1921 22 amounted to £11,804,991, of which £3,478,021 was devoted to railways and tramways, and £4,431,854 to land purchases for settlement. The aggregate public debt at 30th June, 1922, was £109,099,199 -equal to £69 9s. 3d. per head of the population.

9. LAND SETTLEMENT.—The area of Victoria, as already stated, is 56,245,760 acres, and at the end of 1921 the area absolutely alienated was 24,903,109 acres, or 44 per cent. There were 8,778,124 acres in process of alienation, that is to say, the land was held under tenure which will be converted into freehold after the completion of certain conditions of residence, improvements, &c., while 8,993,413 acres were held under lease or licence from the

Lands and Mining Departments, the balance being unoccupied. Of the total area occupied at the 30th June, 1921, the area cultivated was 6,425,250 acres, of which 2,295,865 acres were under wheat.

In order to provide land for settlers the Closer Settlement Board was created with power to purchase estates, cut them into allotments, and dispose of them to settlers on easy terms. At 30th June, 1922, the total area acquired was 582,676 acres, including certain Crown lands transferred without purchase, costing £4,346,387. Nearly the whole of this area has been cut up into 5,076 holdings, with a resident population of 20,304.

10. Irrigation.—Great progress has been made with irrigation since the management was placed in 1905 in the hands of the State Rivers and Water Supply Commission. Several water supply construction works have been constructed or are in course of construction, including the Waranga Reservoir, with a storage capacity of 333,400 acre-feet, already complete; the Sugarloaf Reservoir, which, when finished, will store about 300,000 acre-feet; and the Wimmera Reservoir, with 118,000 acre-feet. The area under irrigated culture in the whole State in 1921 22 was 287,907 acres. A total of 149,970 acres has been subdivided under the Closer Settlement Act into 3,340 blocks. Prior to the introduction of irrigation this area provided for 209 families, and subsequently thereto 3,181 families. The Mildura irrigation settlement is under the management of a Trust, and was founded in 1887. When originated the population was practically nil, while the census of 1921 gave the population of the Mildura Shire as 13,183.

11. Railways and Tramways. –The first railway—Melbourne to Sandridge, or Port Melbourne as it is now called –was opened in 1854, and was the forerunner of the present network of railways throughout Victoria.

Practically the whole of the railways of the State are owned by the Government, and at the 30th June, 1922, there were 4,372 miles of State railways, the whole of which, with the exception of about 124 miles, were built on the 5 ft. 3 in. gauge. The capital cost of the State railways and equipment was £63,186,759; and in 1921–22 the number of train miles travelled was 16,522,658, the number of passenger journeys 149,223,529, and 7,491,031 tons of goods and live stock were carried. The receipts for the same year were £10,857,853 and the working expenses £8,287,146. There are also 25 miles of private railways. The electrification of the Melbourne suburban railways is now complete. The various tramway systems in Victoria comprise 46 miles of cable lines and 105 miles of electric lines. The Melbourne tramways are controlled by a Board appointed by the State Government, while those in other towns are run by companies. Seven miles are controlled directly by the Railway Department. Altogether 234,544,000 passenger journeys were made on the trains in 1921–22.

12. Primary Production.—In Victoria agricultural production is a very important item. During the year 1921 22 the production of wheat was 43,867,596 bushels; of oats, 6,082,258 bushels; of barley, 2,336,246 bushels;

and of potatoes, 173,660 tons. Naturally the quantity of agricultural products depends greatly upon weather conditions, and the quantity of wheat produced in 1921–22 is the third largest on record, having been exceeded in 1915–16 with 58,521,706 bushels and in 1916–17 with 51,162,438 bushels; while the only other years in which the output exceeded 30,000,000 bushels were 1917–18 with 37,737,552 bushels and 1920–21 with 39,468,625. The yield of oats showed a falling off of nearly five million bushels as compared with the previous year; while the yields of barley and of potatoes were not far from the maximum.

The number of horses on 1st March, 1922, was 496,124; of cattle, 1,750,369; of sheep, 12,325,818; and of pigs, 230,770. The maximum figures for any individual year were—horses, 1913, 562,331; cattle, 1894, 1,833,900; sheep, 1918, 15,773,902; and pigs, 1911, 348,069.

The total wool clip for 1921–22 was 78,195,346 lbs., as against 100,986,431 for 1918–19, the maximum in any one year. In addition, the amount of wool on skins exported in 1921–22 is estimated at 25 million pounds.

The dairying industry is also of great importance, numerous butter and cheese factories being distributed over the country. In 1921 the amount of butter made was 82,981,570 lbs.; of cheese, 5,675,909 lbs.; and of bacon and hams, 17,396,798 lbs. Large quantities of butter are annually exported to Great Britain.

The mineral production of Victoria is unfortunately diminishing, and in 1921 amounted in value to £1,543,154 only. The annual production of gold, which reached a maximum of £12,214,976 in 1856, and had never been under £1,000,000 until 1916, had by 1921 fallen to £443,938. In black coal the value of production had risen to £603,323—the maximum, while the quantity of brown coal raised has increased owing to the opening up of the Morwell coal-field by the Electricity Commission, which was appointed in 1919, with power to erect and operate electrical undertakings, to supply electricity, and to establish and operate State coal mines. Works are in progress at Morwell by which the brown coal is won in an open cut system, a power station will be erected with an initial capacity of 50,000 kilowatts, and a plant will be installed capable of supplying annually 96,000 tons of brown coal briquettes.

13. Manufacturing Industries.—Manufacturing industries have increased steadily year by year, until in 1921–22 they had reached the following figures:—Number of factories, 6,753; average number of persons employed, 144,876; amount of salaries and wages paid, £23,846,495; value of plant, machinery, land, and buildings, £40,992,280; and value of output, £106,243,181. Regarding the value of output, the manufacture of hosiery, &c., shows the largest proportionate increase during the last five years—from £643,450 in 1916–17 to £2,297,739 in 1921–22, an increase of 257 per cent. During the

same period the agricultural implement industry showed an increase of 140 per cent. in the value of output; forest saw-mills, 210 per cent.; woollen mills, 146 per cent.; and confectionery, 80 per cent.

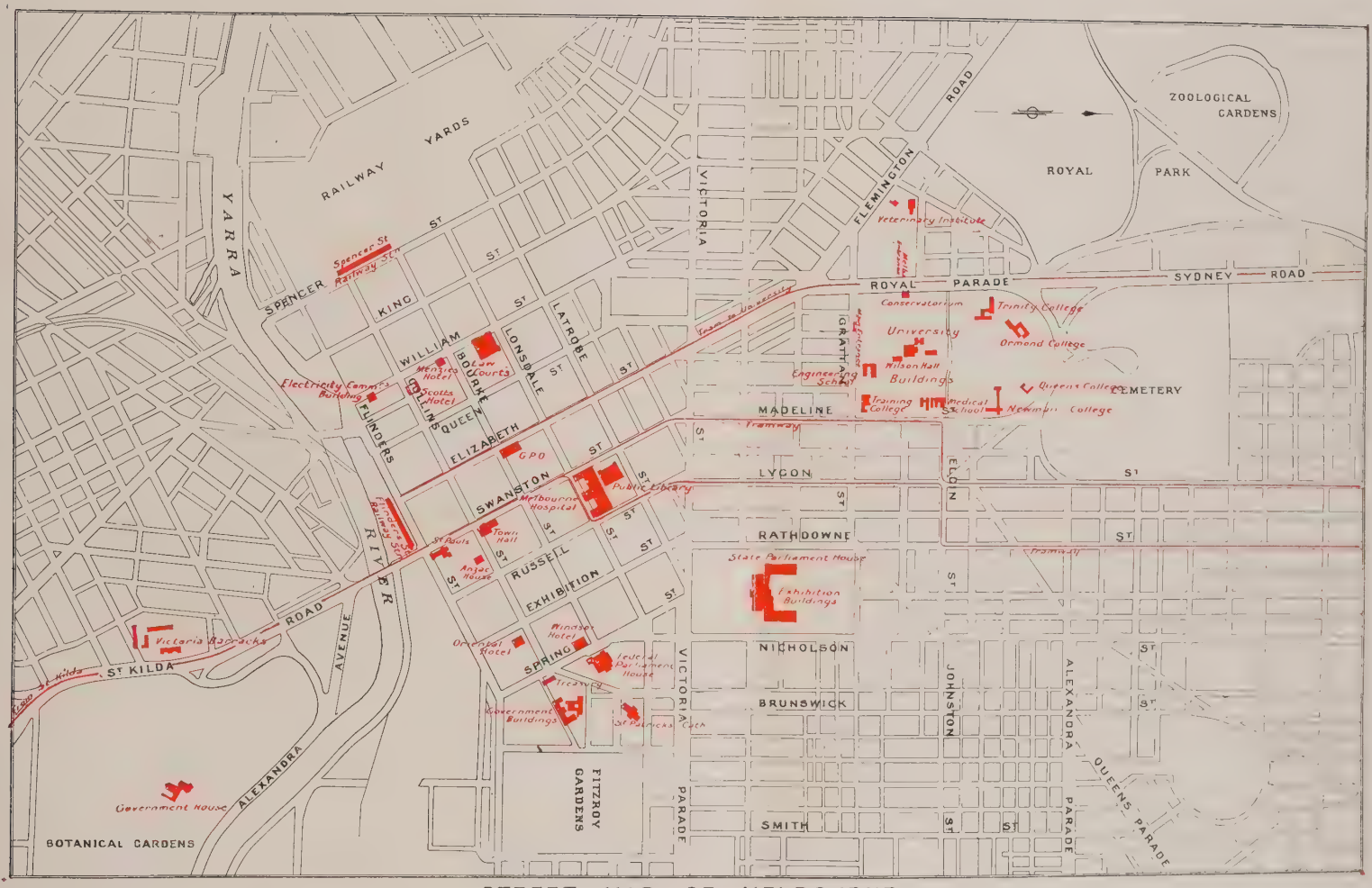
14. Oversea Trade.—The trade of Victoria with other countries is very large, and in the year 1921-22 the value of oversea imports was £36,352,167, and of oversea exports £34,710,500. Of the former, apparel, textiles, and manufactures thereof accounted for £12,403,352, and machinery and manufactures of metal for £7,741,338; while of the latter, foodstuffs, £19,350,950, and animal substances, such as wool, skins, &c., £11,972,700, were the chief items.

15. Education.—The education of children has played a prominent part in the legislation of Victoria for many years past. Prior to 1848 education was left to private enterprise, but in that year a denominational system was introduced and administered by a Board, a subsidy being granted by the State. On the separation of the colony, a Board of National Education was established "for the formation and management of schools to be conducted under Lord Stanley's national system of education, and for administering the funds in connexion therewith." These two systems were abolished in 1862, and a single Education Board appointed. Under the Act of 1872 primary education was made free, compulsory, and secular, and has remained so until the present time, all children between the ages of six and fourteen years being now compelled to attend school. At the end of the year 1921 the number of State schools was 2,425, with 7,283 teachers, and practically every child in Victoria now receives primary education.

In the domain of higher education, the State now provides several district high schools and higher elementary schools, while State technical schools—both senior and junior—can be also availed of.

The University of Melbourne, which was incorporated in 1853, is endowed by the State Government, and the diplomas granted by it are recognised all over the world. The number of students in 1921 was 2,654. There are also several colleges affiliated with the University, and numerous primary and secondary schools not under State control.

16. Public Benevolence.—In the matter of hospitals, Victoria is well provided for, and every town of any importance has now its public hospital or hospitals. Among the more important may be mentioned the Melbourne Hospital, which has 358 beds, and treated 6,466 in-patients in the year 1920–21; the Alfred Hospital, St. Vincent's Hospital, and the Homœpathic Hospital, in Melbourne; and the Ballarat, Bendigo, and Geelong hospitals. Altogether the number of beds available in 1921-21 in all hospitals was 3,635, and the number of in-patients treated 35,233. In additions to the hospitals, there are numerous other public institutions supported by public subscriptions and Government subsidies, such as the benevolent asylums, old men's homes, asylums for the deaf and dumb, and for the blind, &c.



STREET MAP OF MELBOURNE

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In May, 1836, Governor Bourke sent over George Stewart, a police magistrate, to report on the settlement, and he found 177 people settled upon or near the site of Melbourne. Later on in the same year Captain William Lonsdale was despatched to the new settlement as magistrate, with authority to generally superintend its affairs. The present site of Melbourne was eventually determined by Lonsdale, being the place where the greatest number of persons resided " and the most convenient place for the performance of my civil duties " ; due regard was also given to the presence of fresh water in the Yarra above the falls. The town was named after the Prime Minister, Lord Melbourne.

In 1837 the Governor of New South Wales, Sir Richard Bourke, visited the infant settlement, and after inspection approved of the general plan of the town as laid out by Russell, naming the town as well as several of the streets.

2. First Land Sales.—The first sale of blocks of land in Melbourne was held in June of 1837, about two hundred persons being present, and the average price realized for half-acre blocks was £35.

3. Incorporation of Melbourne. Melbourne was incorporated as a town in 1842 by an Act which, with a few slight amendments, is still in force. Originally the Town Council consisted of a Mayor with one Alderman and three Councillors for each of the four wards into which the town was divided. In 1850 a portion of Gipps Ward was formed into the Municipality of Collingwood, while in 1905 the Boroughs of Flemington and Kensington and of North Melbourne were united to the City of Melbourne, with the result that at the present date the City comprises eight wards, each represented by one Alderman and three Councillors.

On the 25th June, 1847, the Town of Melbourne was, by Royal Letters Patent, constituted a City ; and in 1902 the title of Lord Mayor was conferred on the Mayor.

4. Development of the City of Melbourne.—The following table gives statistics relating to the City of Melbourne at decennial periods from 1860 to 1920 :—

City of Melbourne Statistics, 1860 to 1920.

Particulars.	1860.	1870.	1880.	1890.	1900.	1910.	1920.
Area .. .. acres	4,000	4,480	4,480	5,020	6,005	7,658	7,658
Population .. No.	41,500	55,798	65,860	73,361	74,569	102,330	108,100
Total Value of Property £1,000	7,534	7,111	9,464	18,084	13,268	34,262	49,807
Revenue .. £	90,218	134,070	121,652	223,878	192,304	639,189	700,959
Expenditure .. £	99,613	133,756	165,158	366,774	211,528	416,855	739,377

5. Melbourne and Suburbs.—In common with other capitals, the actual City of Melbourne is becoming more a centre of business and less a residential area, and consideration must be given to the outlying suburbs. The metropolitan area now known as Melbourne and Suburbs comprises 105,385 acres, with a population of 816,800 on 31st December, 1922. This area includes 21 cities, one town, one borough, and parts of five shires. It might be mentioned that a town may be proclaimed a city when its revenue has reached £20,000. In six of these cities the population exceeds 40,000, and in four the value of rateable property exceeds £10,000,000. Some of the suburban cities are mainly residential, while in others there are extensive business centres and many manufacturing establishments.

6. Town Halls.—There are several fine town halls in the metropolitan area. The foundation stone of the City of Melbourne town hall was laid by Prince Alfred on 28th November, 1867. This town hall is situated at the corner of Collins and Swanston streets, and contains a large public hall, which is capable of holding an audience of 2,000 persons, and which is provided with a fine organ. Amongst the suburban town halls may be specially mentioned those of Prahran, South Melbourne, and Collingwood.

7. Suburban Railways.—From Spencer-street, Flinders-street, and Prince's-bridge railway stations numerous suburban lines radiate, and a frequent service of trains is provided for the convenience of persons whose business obliges them to visit the city daily. The conversion of the service from steam to electric has been completed recently, and has resulted in a faster, cleaner, and more frequent service of trains, together with a reduction in cost. It is stated that at the Flinders-street Railway Station more passengers pass in and out daily than in any other single railway station in the world.

8. Tramways.—A system of cable tramways was introduced in 1886, the first line opened being that from Richmond to Spencer-street. Altogether there are nearly 46 miles of double track leading from the city to Brunswick, St. Kilda, Carlton, &c. These trams were formerly controlled by the Melbourne Tramway and Omnibus Company, but in 1916, on the expiration of the company's lease, they were handed over to the Melbourne and Metropolitan Tramways Board appointed by the Government. Electric tramways were introduced later and were run by Municipal Trusts, with the exception of the North Melbourne–Essendon line, which was in the hands of a company. All these have now been taken over by the Melbourne and Metropolitan Tramways Board. Altogether, including cable tramways, there are 96 miles of double and 21 miles of single track under the control of the Board; and in 1921–22 the number of passenger journeys was 218,450,000. There are also two electric street railways—one from St. Kilda to Brighton, and the other from Sandringham to Black Rock—worked by the Railway Department in conjunction with the railways.

9. Houses of Parliament.—The Houses of Parliament at the top of Bourke-street are magnificent, but are as yet incomplete. Since Federation they have been occupied by the Federal Parliament, that of Victoria being housed in an annexe to the Exhibition Building at Carlton. The interior is well fitted up for the purpose for which it was built, and contains in addition to the legislative chambers and other accommodation a library of over 40,000 books.

10. Exhibitions.—Several exhibitions have been held in Melbourne, those of 1880 and 1888 having been housed in the large building at Carlton which still stands, and the dome of which is one of Melbourne's landmarks.

11. Parks and Gardens.—Greater Melbourne is well supplied with public reserves and parks, the total area devoted to such purposes being 6,212 acres. The largest Park—Royal Park—has an area of 425 acres. The Botanic Gardens and Domain have a total area of 188 acres, and the former are renowned for their beauty, having been under the care first of Baron von Mueller, the celebrated botanist, and then of Mr. W. R. Guilfoyle, whose knowledge of landscape gardening was largely utilized in laying out the grounds. On the left bank of the Yarra are the beautiful Alexandra and Queen Victoria Gardens, which replace what were formerly desolate areas. These latter gardens are adjacent to the handsomely laid out St. Kilda-road.

12. Churches.—Melbourne is well supplied with churches of all denominations. The first Anglican church was built in 1838 near the Customs House. The foundation stone of St. James's Church in Little Collins-street was laid in 1839, but the building took several years to erect. For many years this was the head-quarters of the Church of England, and was endowed with a large allotment of land adjacent thereto. This building has been pulled down and re-erected in King-street further north. It was not until 1880 that the foundation stone of the present Anglican cathedral—St. Paul's was laid, but the building has not been completed, the towers not having been erected. The Roman Catholic Cathedral—St. Patrick's—was commenced in 1850, and, like the Anglican Cathedral, is also not completed. Other denominations, such as the Presbyterian, Methodist, Congregationalist, and Baptist, have also fine city churches. There are as well numerous churches of all denominations in the suburbs.

13. Schools.—State schools are dotted about the city and suburbs, while there are several "public schools" for boys, such as the Church of England Grammar School, Wesley College, Scotch College, and Xavier College. For girls the Church of England Grammar School, the Presbyterian Ladies' College, and the Methodist Ladies' College may be mentioned.

14. University.—The University of Melbourne was established by Act of Parliament in 1853. It was formally opened in 1855, and has now a staff of 24 professors, 75 lecturers and demonstrators, and 133 assistants. The number of students attending lectures in 1921 was 2,654, of whom 651 were females. By Royal Letters Patent issued in 1859 its degrees are declared of

equal status with those of any other University in the British Empire. The University buildings are situated on 106 acres of land in Carlton. Affiliated with the University are various colleges, such as Trinity College, Ormond College, Queen's College, and Newman College. The Australian College of Dentistry is also affiliated.

15. Hospitals, etc.—The largest and oldest of the metropolitan hospitals is the Melbourne Hospital, the foundation stone of the original building having been laid in 1846. The present building, which was commenced in 1910, contains 358 beds, and during the year 1920–21 treated 6,466 indoor patients. The Alfred Hospital has accommodation for 126 patients, St. Vincent's for 126, the Homœopathic for 98, and the Austin Hospital for Incurables for 290 patients. Amongst other metropolitan hospitals are the Women's Hospital, the Queen Victoria Memorial Hospital for Women and Children, the Children's Hospital, and the Eye and Ear Hospital. There are also several convalescent homes, free dispensaries, sanatoria for consumptives, and other similar institutions. These are all supported by private benevolence, assisted by Government subsidies and grants.

16. Benevolent Asylums, etc.—For the aged poor there are the benevolent asylum and the old colonists' home; for the deaf and dumb, the Victorian Deaf and Dumb Institution; and for the blind, the Royal Victorian Institute for the Blind. There are also smaller charitable institutions as well as several societies founded with the object of dispensing charity.

17. Museums, etc.—The building which houses the public library, art gallery, and National Museum was commenced in 1854, and added to from time to time, the latest addition being the dome portion in which the reference library is housed. At the end of 1921 the reference library contained 282,103 volumes, while the National Gallery contained 20,097 works of art. The Gallery is largely indebted to the Felton Bequest for the periodical addition of pictures and other works of art, from which bequest the average sum of £8,000 is expended annually.

The National Museum contains a representative collection of natural history specimens, and is especially rich in articles manufactured by the aborigines of Australia.

There is also a newspaper room to which a copy of every newspaper published in Victoria must be forwarded.

18. Water Supply.—Originally the water supply of Melbourne was in the hands of the City Council, but in 1853 the duty of supplying the metropolis was transferred to the Commissioner of Sewers. In 1891 the Melbourne and Metropolitan Board of Works, comprising members elected by the various metropolitan municipal councils interested, was created with the object of taking over and extending existing waterworks and of providing an adequate sewerage system. There are at present three sources of water supply

known as the Yan Yean, the Maroondah, and the O'Shanassey systems. The total catchment area from which water is collected for the three systems is 102,000 acres, and the total output for the year 1921 was over 17,000 million gallons. At the 30th June, 1922, the number of houses served was 184,453, and of population served 802,144. The average daily supply is equal to nearly 60 gallons per head.

19. Sewerage.—Prior to the creation of the Melbourne and Metropolitan Board of Works, the pan system for the disposal of sewage was in operation; but when the Board took control plans were prepared for the construction of sewers and the treatment of sewage. Practically the whole of the metropolitan area is now sewered. The sewers lead to the pumping station at Spotswood, where the sewage is strained, the solid matter being transferred to a drier and subjected to steam pressure. The balance of the sewage is raised 125 feet, and gravitates to the sewage farm at Werribee, where it irrigates a large portion of the total area of the sewage farm, which is now 13,219 acres in extent. At the 30th June, 1922, the number of houses connected with sewers was 166,871.

20. Harbor Trust.—The Melbourne Harbor Trust was constituted in 1876, and consists of five members appointed by the Governor. The Port of Melbourne, which is vested in the Commissioners, consists of that part of Hobson's Bay north of a line from Williamstown to St. Kilda, including the River Yarra as far up as Queen's-bridge, and the Saltwater River as far as Maribyrnong-bridge. The principal works carried out have been the construction of the Coode Canal, which cut off a portion of the River Yarra; the deepening of that river; the construction of wharfs and of the Victoria Dock, near the city; and the erection of piers at Port Melbourne and Williamstown. Channels have also been dredged in the bay. Large steamers can now come up the river, and at Prince's Pier, Port Melbourne, vessels up to 25,000 tons burden have been moored.

21. Fire Brigade.—The Melbourne Fire Brigade is recognised as thoroughly up to date. At the 30th June, 1922, there were under the control of the Metropolitan Fire Brigade Board—under the management of which the brigade is placed—270 members of the permanent staff, 50 of the special service staff, 7 of the clerical staff, 31 men engaged in the workshops, and 100 partially paid firemen; while the plant, distributed over 41 stations, comprised 5 motor-drawn steam fire-engines, 2 steam fire-engines, 4 petrol motor fire-engines, together with salvage waggons, extension ladders, fire escapes, &c.

V.—SPECIAL NOTICES.

1. Tram Routes to University.

Members may reach the University from the City—(1) by the Elizabeth-street (red) tram, alighting at Story-street (Melba Hall entrance), or Morrah-street (avenue entrance), fare 2d.; or (2) by the Swanston-street (red or green) tram, alighting at Faraday-street and walking west two blocks, fare 2d.; or (3) by the Swanston-street (yellow or white) tram to Queensberry-street, transferring to the electric tram, and alighting at Faraday-street entrance, fare 2½d. (with transfer).

2. Information Office.

All information available with regard to arrangements may be obtained on application to the Information Office (University Union Billiard Room), which will be open from 9.30 a.m. daily, except on Monday, 13th August, when it will open at 10.30 a.m.

3. Members' Badges.

Members may obtain their badges on Monday, 13th August, at the Information Office, at the University Union Buildings. They are requested to sign the Members' Book there as soon as possible after arrival. Members are reminded of the importance of having their Congress Badges always with them, as this will be their only means of admission to the various meetings, lectures, receptions, luncheon-room, and excursions.

4. Lunch.

Lunch may be obtained in the Union Luncheon Rooms daily (except Saturday) from 12.30 to 2 p.m., morning tea daily from 10.30 to 11.30 a.m., and afternoon tea daily (except Wednesday and Saturday) from 3 to 5 p.m. Lunch, 2s.; morning or afternoon tea, 9d.

5. Postal and Telephone Facilities.

Post-office facilities will be found in the Information Office, where the times of clearance and delivery of letters will be notified. Members are asked to inquire regularly for letters. Stamps may be obtained at the Information Office, and telegrams will be despatched therefrom daily, except Saturday afternoon. Public telephones are situated in the Union building (calls 2d. each).

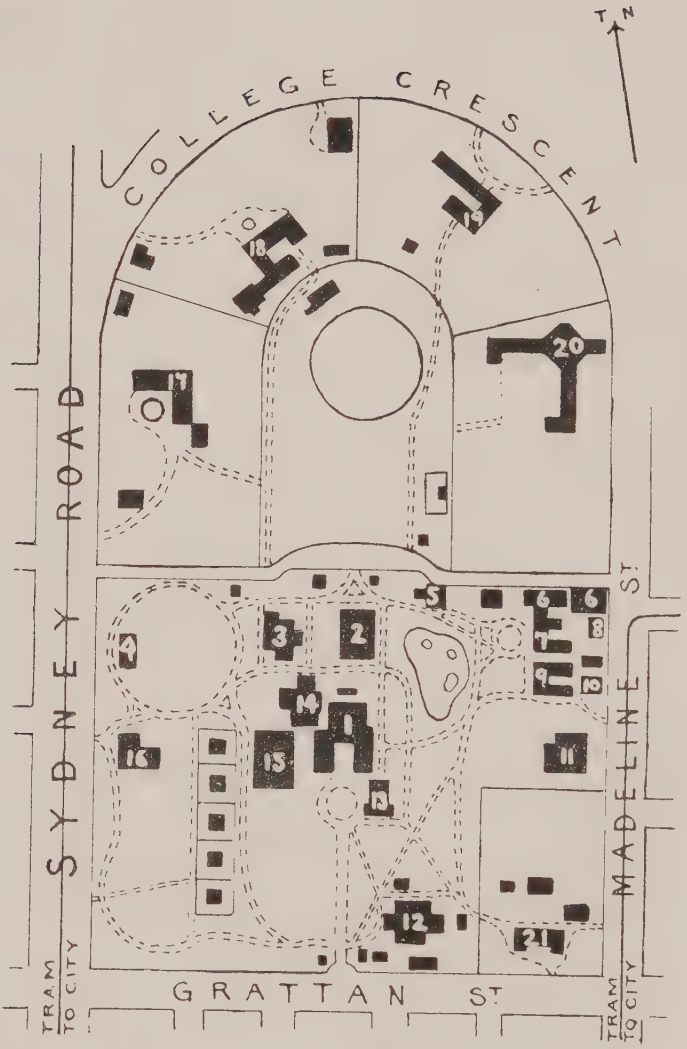
6. Excursions—Directions to Members.

Members are requested to enter their names as early as possible on Monday, 13th August, for all excursions at which they desire to be present, at the excursions counter in the Information Office at the University Union building,

where any necessary tickets or coupons may be obtained. It is to be noted that many of the excursions are strictly limited as regards numbers. Overseas visitors will be given the first opportunity of being present. Priority will then be determined by order of applications of Inter-State visitors who are specially interested in the respective excursions, and then of local members who are similarly interested. A summarized statement of the various excursions, with further directions to members, is given in Part X. of this Handbook.

7. Official Year Book of the Commonwealth.

Through the courtesy of the Commonwealth Statistician (Mr. C. H. Wickens, F.I.A., F.S.S.) copies of the Official *Year-Book* of the Commonwealth of Australia are available for overseas members of the Congress. Each oversea member can obtain a copy on application to the Information Office in the University Union Buildings.



Plan of Melbourne University Grounds.

VI.—SECTIONAL MEETING PLACES AND ALLOCATION OF ROOMS AT MELBOURNE UNIVERSITY.

KEY TO PLAN.

1. Main buildings and library.
2. Reception rooms and offices.
3. Luncheon rooms.
4. School of Agriculture.
5. Biology School (Botany and Zoology).
6. Chemistry School.
7. Physiology School.
8. Medical Lecture Theatres.
9. Medical School.
10. Bacteriology Department.
11. Anatomy School.
12. Geology and Engineering School.
13. Wilson Hall.
14. Physical Department.
15. Arts School.
16. Melba Hall.
17. Trinity College.
18. Ormond College.
19. Queen's College.
20. Newman College.
21. Training College.

ALLOCATION OF ROOMS.

Section.	Meeting Room.	Reference No on Plan.
I. Agriculture	School of Agriculture	4
II. Anthropology and Ethnology	Chemistry School	6
III. Botany	Biology School	5
IV. Entomology	Chemistry School	6
V. Forestry	Physiology School	7
VI. Geodesy and Geophysics	Chemistry School	6
VII. Geography and Oceanography	Medical Lecture Theatres	8
VIII. Geology	Geology and Engineering School	12
IX. Hygiene	Medical Lecture Theatres	8
X. Veterinary Science	School of Agriculture	4
XI. Zoology	Biology School	5
Reception Room	University Union Building	2
Information Office		
Post Office		
Writing and Smoking Rooms		
Ladies' Rest and Writing Rooms		
General Secretaries		
Luncheon Rooms		3

VII.—GENERAL PROGRAMME FOR MELBOURNE MEETING.

MONDAY, 13TH AUGUST, 1923.

10.30 a.m.—Reception Room open at University Union Building.

Afternoon free.

8 p.m.—Opening Meeting at Assembly Hall, 160 Collins-street, Melbourne. Addresses by His Excellency the Governor-General, the President (Sir David O. Masson, K.B.E., M.A., D.Sc., F.R.S., &c.), and representatives of Great Britain, U.S. America, Japan and Holland.

TUESDAY, 14TH AUGUST, 1923.

10 a.m. to 1 p.m.—Sectional Meetings—Papers and Discussions.

2 p.m.—Excursions to—

(*a*) Studley Park.
(*b*) Brighton.
(*c*) National Museum.
(*d*) Victorian Department of Agriculture.
(*e*) Lilydale.
(*f*) Commonwealth Serum Institute.
(*g*) Sassafras.
(*h*) Melbourne Observatory.

8 p.m.—Reception by His Excellency the Governor-General at Federal Government House, St. Kilda-road.

WEDNESDAY, 15TH AUGUST, 1923.

10 a.m. to 1 p.m.—Sectional Meetings—Papers and Discussions.

2 p.m.—Combined Excursion at the invitation of the Melbourne University Association through Parks and Botanical Gardens. Afternoon tea at Church of England Grammar School, St. Kilda-road.

THURSDAY, 16TH AUGUST, 1923.

Whole-day Excursions to—

(*a*) Yallourn (Brown Coal Fields).
(*b*) Bacchus Marsh.
(*c*) Eltham.
(*d*) Werribee Research Farm.
(*e*) Macedon.

8 p.m.—Public Meeting at Assembly Hall, 160 Collins-street, Melbourne, to discuss the Preservation of Native Fauna.

FRIDAY, 17TH AUGUST, 1923.

10 a.m. to 1 p.m.—Sectional Meetings—Papers and Discussions.

Afternoon free.

8 p.m.—Conversazione and Reception by Victorian State Government at State Parliament House.

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST, 1923.

Week-end Excursions to—

(*a*) Macedon.
(*b*) Lancefield.
(*c*) Healesville and Marysville.
(*d*) Mildura.
(*e*) Creswick.

SATURDAY, 18TH AUGUST.

8 p.m.—Public Lecture at Assembly Hall.

MONDAY, 20TH AUGUST, 1923.

Morning free.

2 p.m. to 5 p.m. Sectional Meetings—Papers and Discussions.

TUESDAY, 21ST AUGUST, 1923.

10 a.m. to 1 p.m.—Sectional Meetings—Papers and Discussions.

2 p.m.—Excursions to—

(*a*) Royal Park.
(*b*) Cheltenham.
(*c*) Zoological Gardens.
(*d*) Werribee Sewerage Farm.
(*e*) Macedon.
(*f*) Melbourne Observatory.

WEDNESDAY, 22ND AUGUST, 1923.

10 a.m.—General Meeting of Congress—Resolutions, &c.

Afternoon.—Leave for Sydney.

VIII.—DETAILED PROGRAMMES OF SECTIONAL MEETINGS.

SECTION I.—AGRICULTURE.

Chairman for Melbourne Meeting .. Dr. Elwood Mead, Professor of Rural Institutions, University of California.

Hon. Secretary for Melbourne Meeting .. A. E. V. Richardson, M.A., B.Sc., Department of Agriculture, Melbourne. (Tel. No. C.3252.)

TUESDAY, 14th AUGUST.

10 a.m. to 1 p.m.—

I. Problems relating to Irrigation.

1. The Relation of Land Settlement to Irrigation Development.
2. Conservation and Use of Water in Victoria.
3. The Development of the Murray River Basin.
4. Some Problems awaiting Solution in Irrigated Agriculture.
5. The Cost of Development of Irrigated Farms.
6. The Maintenance of Productiveness on Irrigated Holdings.
7. Factors affecting the Yield of Irrigated Lucerne.

2 p.m.—Excursion to Captain A. E. T. Payne's Stud Farm, "Yarra View," Lilydale.

WEDNESDAY, 15th AUGUST.

10 a.m. to 1 p.m.—

II. Problems relating to Agricultural Education and Research.

Discussion to be introduced by Professor A. J. Perkins, Director of Agriculture, South Australia.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16th AUGUST.

Whole-day Excursion to State Research Farm, Werribee, and the Werribee Irrigation Settlement.

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—

III. GENETICS, WITH SPECIAL REFERENCE TO THE IMPROVEMENT OF FARM ANIMALS.

(Joint Meeting with Zoology and Veterinary Science Sections.)

Afternoon.—Leave 4.45 p.m. for week-end excursion to Western District (Warrnambool, Tower Hill, and Port Fairy).

Return 2.4. p.m. on Monday, 20th August.

MONDAY, 20TH AUGUST.

3 to 5 p.m.—

IV. WHEAT DISEASES.

(Joint Meeting with Botany Section.)

1. Prevalence and Methods of Control of Take-all, Flagsmut, and Rust in Victoria.
2. A new Disease of Gramineæ.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—

V. SOIL PROBLEMS, INCLUDING SOIL SURVEYS.

1. Present Status of Chemical Criteria in Soil Fertility Investigations.
2. Nitrogen Fixation.
3. Treatment of Refractory Soils.
4. Double Decomposition following the Application of Artificial Fertilizers.
5. Response of Australian Soils to Phosphatic Fertilizers, with special reference to Root Development.
6. Can the Agricultural Chemist determine the Lime Requirements of the Soil ?
7. Influence of partial Sterilization upon Soil Micro-organisms and their Activities.
8. Soil Surveys in California.

SECTION II.—ANTHROPOLOGY AND ETHNOLOGY.

Chairman for Melbourne Meeting .. Dr. A. C. HADDON, M.A., Sc.D., F.R.S., Cambridge University.

Hon. Secretary for Melbourne Meeting .. E. L. PIESSE, B.Sc., LL.B., Prime Minister's Department, Melbourne. (Tel. No. C.5551.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m. –Cartography of the Pacific. (Joint Meeting with Geodesy and Geography Sections.)

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—

1. Organization of Research among the Natives of Australia and the Islands of the Pacific.
2. Linguistic Problems of the Pacific.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursions with other Sections.

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—

1. Decline in Native Population in the Islands of the Pacific.
2. Variations in Sex Ratios in relation to index of declining Fertility.

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursions with other Sections.

MONDAY, 20TH AUGUST.

Visit to Australian Ethnological Collection at National Museum.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—Decline in Native Population in the Islands. (Joint Meeting with Hygiene Section.)

SECTION III.—BOTANY.

Chairman for Melbourne Meeting .. Professor J. L. JEPSON, University College, California.

Hon. Secretary for Melbourne Meeting .. R. B. PATTON, M.Sc., M.F., University, Melbourne. (Tel. No. C. 7786.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—Joint Meeting with Forestry Section—

1. Forests of Victoria.
2. Big Trees of Australia and California.

Afternoon.—Excursion to Brighton.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—

1. Ecological Studies in Tasmania.
2. Flora of Krakatau.
3. Consideration of subjects for next Congress.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursions to Yallourn (Brown Coal Fields) and Eltham.

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—Joint Meeting with Forestry Section—Antipodean Shortage of Softwoods.

Afternoon.—Excursion to Sassafras.

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursion to Marysville.

MONDAY, 20TH AUGUST.

3 to 5 p.m.—Joint Meeting with Agricultural Section : Wheat Diseases.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—Distribution :

1. Australia's Influence on adjacent Floras.
2. Distribution of Orchids.

Afternoon.—Excursion to Cheltenham.

SECTION IV.—ENTOMOLOGY.

Chairman for Melbourne Meeting .. DR. R. J. TILLYARD, M.A., F.L.S., Cawthron Institute, New Zealand.

Hon. Secretary for Melbourne Meeting .. J. A. KERSHAW, F.E.S., National Museum, Melbourne. (Tel. No. C.3436.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—Parasitological Problems in Veterinary Science and Zoology. The Buffalo Fly. (Joint Meeting with Zoology and Veterinary Science Sections.)

2.30 p.m.—Visit to Museum of Economic Entomology (Department of Agriculture).

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—Introduced Pests and Natural Enemies. (Joint Meeting with Zoology, Botany, and Forestry.)

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursion to Macedon. (Joint with Forestry Section.)

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—

1. The Introduction of beneficial Insects into New Zealand.
2. Distribution of Anopheline Mosquitoes.
3. The Termite Problem as affecting Australia.

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursion to Marysville. (Joint with Zoology and Botany Sections.)

MONDAY, 20TH AUGUST.

Free.

TUESDAY, 21ST AUGUST.

Morning.—Free.

Afternoon.—Excursion to Doncaster.

SECTION V.—FORESTRY.

Chairman for Melbourne Meeting .. ..

Hon. Secretary for Melbourne Meeting .. A. V. GALBRAITH, Forests Commission, Melbourne. (Tel. No. C.8815.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—Joint Meeting with Botany Section—

1. Forests of Victoria.
2. Big Trees of Australia and California.

Afternoon.—Excursion to Sassafras.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—Joint Meeting with Botany, Entomology, and Zoology Sections: Introduced Pests and Natural Enemies.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursion to Macedon. (Joint with Entomology Section.)

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—Joint Meeting with Botany Section : Antipodean Shortage of Softwoods.

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursion to Creswick.

MONDAY, 20TH AUGUST.

2 to 5 p.m.—

1. Seasoning of Hardwood Timbers.
2. Need for Research into Properties of Hardwood Timber.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—Paper Pulp.

SECTION VI.—GEODESY, GEOPHYSICS, RADIOTELEGRAPHY, ETC.

Chairman for Melbourne Meeting .. Colonel SIR GERALD LENOX-CONYNGHAM, R.E., F.R.S., Cambridge University.

Hon. Secretary for Melbourne Meeting .. E. F. J. LOVE, M.A., D.Sc., F.R.A.S., University, Melbourne. (Tel. No. C.7195.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—

I. CARTOGRAPHY OF THE PACIFIC—

1. Present condition of Mapping in Borderlands and Islands.
2. Need for a Geodetic Survey of Australia.
3. Nomenclature in the Pacific.

(Joint Meeting with Anthropology and Geography Sections.)

Afternoon.—Visit to Melbourne Observatory.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—

II. GRAVITATION PROBLEMS—

1. Determination of Gravity at Sea.
2. Isostasy in light of Indian gravitation determinations.
3. Earth Tides.
4. Figure of the Earth : Australia's possible contribution.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursion to Yallourn (Brown Coal Fields).

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—

1. Meteorology of the Pacific.
   (Joint Meeting with Geography Section.)
2. International Solar Physics Research.

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursions with other Sections.

MONDAY, 20TH AUGUST.

2 p.m. to 5 p.m.—

TERRESTRIAL MAGNETISM—

1. Operations in Pacific Regions.
2. The Magnetic Observatory of the Carnegie Institute at Watheroo, W.A.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—

1. Chairman's Address.
2. Longitude—
   (*a*) Precision of Results obtained in wired and wireless Determinations.
   (*b*) Australian Wireless Determinations.

2 p.m. to 5 p.m.—Visit to Melbourne Observatory.

SECTION VII.—GEOGRAPHY AND OCEANOGRAPHY.

Chairman for Melbourne Meeting .. Professor N. YAMASAKI, Tokyo University.

Hon. Secretary for Melbourne Meeting .. Captain J. K. DAVIS, Commonwealth Navigation Service, 150 Little Flinders-street, Melbourne. (Tel. Nos.—Day, C.714; night, C.3369.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—

I. CARTOGRAPHY OF THE PACIFIC—

1. Present condition of Mapping in Borderlands and Islands.
2. Need for a Geodetic Survey of Australia.
3. Nomenclature in the Pacific.
   (Joint Meeting with Anthropology and Geodesy Sections.)

Afternoon.—Visit to National Museum.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—

II. GEOGRAPHY AND OCEANOGRAPHY SECTION—

1. The value of the hydrographical work of the Royal Navy in opening Australasian waters to navigation and the importance of the continuation of this work by the Australian Navy.
2. Importance of completing survey of the Great Barrier Reef, and the possibility of shortening the distance for full-powered steamers between the Arafura and Coral Seas.
3. The establishment of an Oceanographical Institute in Australia.

Afternoon. Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursions with other Sections.

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—

III. METEOROLOGY OF THE PACIFIC—

1. Unification of meteorological services in the Pacific Islands for storm warnings.
2. Correlation of meteorological elements with a view to seasonal forecasts. Storm areas and Australian weather.
3. Provision of international meteorological information for possible airship and aeroplane traffic.

(Joint Meeting with Geodesy Section.)

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursions with Sections.

MONDAY, 20TH AUGUST.

2 p.m. to 5 p.m.—

IV. OCEANOGRAPHY—

1. Ocean currents of the south-western Pacific, with special reference to Australia, New Zealand, New Caledonia, and the East Indies.
2. The need of a Pacific chart showing accurately the co-tidal lines.
3. The Sonic depth finder.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—

V. EXPLORATION—

Regions unexplored, especially in Melanesia.

SECTION VIII.—GEOLOGY.

Chairman for Melbourne Meeting .. Dr. H. A. Brouwer, University, Delft.

Hon. Secretary for Melbourne Meeting .. Professor E. W. Skeats, D.Sc., F.G.S., University, Melbourne. (Tel. No. C.4448.)

TUESDAY, 14th AUGUST.

10 a.m. to 1 p.m.—

1. Demonstrations and Exhibition of Specimens illustrating Excursions, &c.
2. Contributed Papers.

Afternoon.—Excursion to Royal Park and Moonee Ponds Creek.

WEDNESDAY, 15th AUGUST.

10 a.m. to 1 p.m.—

I. Correlation of Kainozoic Formations in the Pacific. Leader: Dr. T. W. Vaughan.

1. Introduction.
2. Brief Summaries bringing the statements in the Proceedings of First P.P.C. up to date.
   - (*a*) South America.
   - (*b*) Central America, West Indies, Mexico, S.E. United States.
   - (*c*) West N. America.
   - (*d*) Japan.
   - (*e*) Philippines.
   - (*f*) New Zealand.
   - (*g*) Oceania.
3. Terrestrial deposits of Japan and their interrelation with the marine deposits.
4. The Tertiary Formations of Papua.
5. The Tertiary Formations of New Caledonia.
6. The Tertiary Formations of Australia.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16th AUGUST.

Whole-day Excursion to Coimadai and Werribee Gorge.

FRIDAY, 17th AUGUST.

10 a.m. to 1 p.m.—

II. Post-Mesozoic Volcanic Action within the Pacific Region. Leader: Professor E. W. Skeats.

1. General Statement of Problem.
2. Volcanic Rocks in Australia, New Zealand, and Antarctica.
3. Vulcanism in Nederlands of East Indies.
4. Volcanic Rocks in Western America.
5. Volcanic Rocks in Pacific Islands.
6. Volcanic Rocks in the Philippines.
7. Volcanic Rocks in Japan, China, and Formosa.

Afternoon.—Excursion to Studley Park.

SATURDAY, 18th AUGUST.

Whole-day Motor Excursion to Macedon and Woodend. Stay night at Woodend.

SUNDAY, 19th AUGUST.

Whole-day Motor Excursion from Woodend to Lancefield and Romsey. Return Melbourne 6 p.m.

MONDAY, 20th AUGUST.

10 a.m. to 1 p.m.—

III. Structure of the Pacific Basin (1st Part). Leader: Dr. P. Marshall.

1. General Statement of the Problem.
2. Structure of Australia and Antarctica.
3. Structure of New Zealand.
4. Structure of New Caledonia.
5. The Growing Mountain Ranges of the Pacific.
6. The Doctrine of Isostasy in its relation to mountain building in the Pacific and Indian regions.

2 p.m. to 5 p.m.—

IV. Structure of the Pacific Basin (2nd Part).

1. Structure of New Guinea.
2. Structure of East Indies, New Guinea, &c..
3. Structure of East Indies.
4. Structure of Central America and West Indies.
5. Structure of the Philippines.
6. Structure of Japan (including Formosa).
7. Structure of British Columbia.
8. Structure of Alaska.

TUESDAY, 21st AUGUST.

V. Geographical and Geological Distribution of Ore Provinces in the Pacific Region, with Special Reference to Australia and the Outlying Islands. Leader: E. C. Andrews—

1. General distribution of Ore Provinces within the Pacific Region.
2. Ore Provinces in Australia—
   (*a*) Western Australia.
   (*b*) South Australia.
   (*c*) Queensland.
   (*d*) New South Wales.
   (*e*) Victoria.
   (*f*) Tasmania.
   (*g*) Northern Territory.
3. Correlation of Ore Provinces in Australia.
4. Ore Provinces in Western, W. and S. America.
5. Ore Provinces in Outlying Islands and their relation to Australian Ore Provinces.
6. Ore Provinces in Japan, Formosa, China, &c.

SECTION IX.—HYGIENE.

Chairman for Melbourne Meeting .. Dr. R. R. Sayers, Chief Surgeon, United States Bureau of Mines; Surgeon, United States Public Health Service.

Hon. Secretary for Melbourne Meeting .. J. H. L. Cumpston, M.D., B.S., D.P.H., F.San.I., Director-General, Commonwealth Department of Health, Melbourne. (Tel. No. C.5374.)

TUESDAY, 14th AUGUST.

10 a.m. to 1 p.m.—

I. Programme on Mining Hygiene—

1. Dust Diseases and the Different Types of Silicosis and Lead Poisoning.
2. Metal Mine Ventilation, with Special Reference to the Use of Flexible Canvas Tubing.
3. Ventilation and Dust Control in Metal Mines.
4. Ventilation, Hygiene, and Accidents in Coal Mines.
5. Exhibit showing Methods of Dust Prevention, Broken Hill South Mine.

Afternoon.—Excursion to the Commonwealth Serum Laboratory, Royal Park.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—

1. Coal Mine Sanitation (Chairman's Address).
2. Hookworm Disease in Australian Mines.
3. Health of Native Miners in the New Guinea Copper Mines.
4. Underground Hygiene in Metal Mines.
5. Mine Hygiene from the Worker's Point of View.

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursion to Yallourn Brown Coal Fields.

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—

II. PROGRAMME OF HYGIENE OF THE PACIFIC REGION—

1. General Survey of the Field of Public Health in the Pacific (including a Summary of the Replies to a Questionnaire on Health Problems of the Pacific Region).
2. A Survey of Yellow Fever on the Pacific Littoral and the Risk of its introduction into Asia, Australasia, and the Pacific Islands.
3. Discussion of Malaria and Filariasis.
4. Discussion of Outstanding Health Problems by Delegates from the Pacific Region.

2 p.m. to 5 p.m.—International Notification of Animal Diseases and Establishment of Department of Animal Health. (Joint Meeting with Veterinary Science Section.)

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Excursion to Marysville.

MONDAY, 20TH AUGUST.

2 to 5 p.m.—

1. The Control of Plague amongst Native Races.
2. The Control of Small-pox amongst Native Races.
3. The Common Diseases of the Samoan, with reference to their Prevention and Cure.
4. The Risk of the Introduction of Non-endemic Leprosy by International Migration.
5. Discussion of Methods of Co-operation in Public Health Matters in the Pacific.

TUESDAY, 21ST AUGUST.

10 a.m. to 1 p.m.—

Joint Session with the Section of Anthropology and Ethnology. (General subject : Causes of the Decline of Native Races in the Pacific Islands)—

1. Address—

   Dr. C. J. Martin, Director of the Lister Institute, London.

2. Discussion of Social Factors.
3. Discussion of Health Factors.

Afternoon.—Excursion to Sewage Farm, Werribee.

SECTION X.—VETERINARY SCIENCE.

Chairman for Melbourne Meeting .. Professor NITTA, Tokyo University.

Hon. Secretary for Melbourne Meeting .. Professor H. A. WOODRUFF, M.R.C.V.S., M.R.C.S., L.R.C.P., University, Melbourne. (Tel. No. C.7143.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—Parasitological Problems in Veterinary Science and Zoology. (Joint Meeting with Entomology and Zoology Sections.)

Afternoon.—Visit to Commonwealth Serum Institute.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—Agricultural Education and Research. (Joint Meeting with Agriculture Section.)

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Morning.—Free.

Afternoon.—Excursions with other Sections. (Meeting of Australian Veterinary Association.)

FRIDAY, 17TH AUGUST.

10 a.m. to 5 p.m.—Genetics, with special reference to the Improvement of Farm Animals. (Joint Meeting with Agriculture and Zoology Sections.)

2 to 5 p.m.—International Notification of Animal Diseases and Establishment of Department of Animal Health. (Joint Meeting with Hygiene Section.)

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Week-end Excursions with other Sections.

MONDAY, 20TH AUGUST.

Free.

TUESDAY, 21ST AUGUST.

Free.

SECTION XI.—ZOOLOGY.

Chairman for Melbourne Meeting .. Professor W. E. RITTER, Director, Scripps Institute, La Jolla, Cal.

Hon. Secretary for Melbourne Meeting .. Professor W. E. AGAR, M.A., D.Sc., F.R.S., University, Melbourne. (Tel. No. C.3733 and Hawthorn 114.)

TUESDAY, 14TH AUGUST.

10 a.m. to 1 p.m.—Parasitological Problems in Veterinary Science and Zoology (Joint Meeting with Entomology and Veterinary Science Sections.)

Afternoon.—Visit to Melbourne National Museum.

WEDNESDAY, 15TH AUGUST.

10 a.m. to 1 p.m.—Introduced Pests and Natural Enemies. (Joint Meeting with Botany, Entomology, and Forestry Sections.)

Afternoon.—Visit to Parks and Botanical Gardens.

THURSDAY, 16TH AUGUST.

Whole-day Excursion to Eltham.

FRIDAY, 17TH AUGUST.

10 a.m. to 1 p.m.—Genetics, with special reference to the Improvement of Farm Animals. (Joint Meeting with Agriculture and Veterinary Science Sections.)

SATURDAY AND SUNDAY, 18TH AND 19TH AUGUST.

Excursion to Healesville and Marysville.

MONDAY, 20TH AUGUST.

10 a.m. to 1 p.m.—Fisheries and Marine Biological Stations.

TUESDAY, 21ST AUGUST.

2 p.m to 5 p.m.—Adjourned discussions, &c.

Afternoon.—Visit to Zoological Gardens.

IX. SUMMARIZED TABULAR STATEMENT OF PAPERS,

Note.—J.M. signifies Joint Meeting.

Session.	I. Agriculture.	II. Anthropology and Ethnology.	III. Botany.	IV. Entomology.	V. Forestry.	VI. Geodesy, Geophysics, &c.
Tuesday, 14th Aug., 10 a.m. to 1 p.m.	Irrigation Problems	J.M. Geodesy and Geography—Cartography of the Pacific	J.M. Forestry— 1. Forests of Victoria 2. Big Trees of Aust., and California	J.M. Veterinary Science and Zoology—Parasitological Problems in Vet. Science and Zoology	J.M. Botany— 1. Forests of Victoria 2. Big Trees of Aust., and California	J.M. Anthropology and Geography—Cartography of the Pacific
	Agricultural School	..	Physiology Lecture Room	Zoology Theatre	Physiology Lecture Room	Medical Theatre
Wednesday, 15th Aug., 10 a.m. to 1 p.m.	Problems relating to Agri. Education and Research J.M. Vet. Science	1. Organization of Research among the Natives of the Islands of the Pacific 2. Linguistic Problems	1. Ecological Studies in Tasmania 2. Flora of Krakatau 3. Subjects for next Congress	J.M. Zoology and Forestry—Introduced Pests and Natural Enemies	J.M. Entomology. Zoology—Introduced Pests and Natural Enemies	Gravitation Problems— 1. Dtn. of gravity at Sea 2. Isostasy in light of Indian gravity detns. 3. Earth Tides 4. Figure of the Earth: Australia's possible contribution
	Agricultural School	Chemistry School	Zoology Theatre	Zoology Theatre	Zoology Theatre	Cuming Theatre (Chemistry)
Friday, 17th Aug., 10 a.m. to 1 p.m.	J.M. Zoology and Vet. Science Genetics with special reference to improvement of farm animals	1. Decline in Native Population in the Islands of the Pacific 2. Variations in Sex Ratios	J.M. Forestry—Antipodean Shortage of Softwoods	1. Introduction of Insects into New Zealand 2. Distribution of Anopheline Mosquitoes 3. The Termite Problem	J.M. Botany—Shortage of Softwoods	J.M. Geog. and Oceanog. 1. Meteorology of the Pacific 2. International Physical Research
	Zoology Theatre	Chemistry School	Botany Lecture Room	Chemistry Theatre	Physiology Lecture Room	Medical Theatre
Monday, 20th Aug., 2 p.m. to 5 p.m.	J.M. Botany—Wheat Diseases	..	J.M. Agriculture—Wheat Diseases	..	1. Seasoning of Hardwood Timbers 2. Need for Research into the properties of Hardwood Timbers	Terrestrial Magnetism in Pacific Regions
	Agricultural School	..	Agricultural School	..	Physiology Lecture Room	Cuming Theatre (Chemistry)
Tuesday, 21st Aug., 10 a.m. to 1 p.m.	Soil Problems	Decline in Native Population in Islands J.M. Hygiene	Distribution— 1. Australia's Influence on adjacent Floras 2. Distribution of Orchids	..	Paper Pulp	Special Communications from visiting Delegates
	Agricultural School	Physiology Theatre	Botany Lecture Room	..	Physiology Lecture Room	Cuming Theatre (Chemistry)

DISCUSSIONS AND JOINT MEETINGS OF SECTIONS.

Note.—J.M. signifies Joint Meeting.

VII. Geography and Oceanography.	VIII. Geology.	IX. Hygiene.	X. Veterinary Science.	XI. Zoology.
J.M. Geodesy, &c. Cartography of the Pacific— 1. Present Conditions of mapping in Borderlands and Islands 2. Need for Geodetic Survey of Australia 3. Nomenclature in the Pacific	1. Demonstrations and Exhibition of Specimens 2. Contributed Papers	Mining Hygiene— 1. Dust Diseases: Silicosis; Lead Poisoning 2. Ventilation and Dust Control 3. Exhibit of Methods of Dust Prevention	J.M. Zoology and Entomology— Parasitological Problems	J.M. Vet. Science and Entomology— Parasitological Problems
Medical Theatre	Geology Theatre	Physiology Theatre	Zoology Theatre	Zoology Theatre
1. Value of Hydrographical Work of the R.N., &c. 2. Survey of Great Barrier Reef 3. Establishment of Oceanographical Institute in Australia	Correlation of Kainozoic Formations— 1. Introduction 2. Additions to knowledge since 1920 3. Terrestrial deposits of Japan and relation to marine deposits 4. Tertiary formations of Papua 5. Tertiary formations of New Caledonia 6. Tertiary formations of Australia	Mining Hygiene— 1. Coal Mine Sanitation 2. Hookworm Disease in Australian Mines 3. Health of Native Miners 4. Underground Hygiene 5. Mine Hygiene	J.M. Agriculture— Agricultural Education and Research	J.M. Entomology, Forestry Introduced Pests and Natural Enemies
Medical Theatre	Geology Theatre	Physiology Theatre	Agricultural School	Zoology Theatre
J.M. Geodesy, &c.— Meteorology of the Pacific— 1. Unification of Services in Islands 2. Correlation of Meteorological Elements 3. Provision of International Information for Air Traffic	Post-Mesozoic Volc. Action in Pacific— 1. General Statement 2. Volcanic Rocks in Aust., N.Z., and Antarctic 3. Vulcanism in Netherlands and E. Indies 4. Volcanic Rocks in W. America 5. Volcanic Rocks in Pacific Is. 6. Volcanic Rocks in Philippines 7. Volcanic Rocks in Japan, China, and Formosa	Hygiene of the Pacific Region— 1. General Survey 2. Yellow Fever 3. Malaria and Filariasis 4. Discussion on Health Problems 2–5 p.m. J.M. Vet. Science— International Notification	J.M. Zoology and Agriculture— Genetics, with special reference to the improvement of farm animals 2–5 p.m. International Notification of Animal Diseases and Establishment of Dept. of Animal Health	J.M. Agriculture and Vet. Science— Genetics, with special reference to the improvement of farm animals
Medical Theatre	Geology Theatre	Physiology Theatre	J.M. Hygiene Physiology Theatre	Zoology Theatre
Ocean Currents of S.W. Pacific Need for Pacific Chart showing Co-tidal Lines The Sonic Depth Finder	Structure of the Pacific Basin	Hygiene of Pacific Region— 1. Control of Plague 2. Control of Small-pox 3. Diseases of the Samoan 4. Non-endemic Leprosy 5. Discussion on Methods of Co-operation	..	Fisheries and Marine Biological Stations
Medical Theatre	Geology Theatre	Physiology Theatre	..	Zoology Theatre
Regions unexplored, especially in Melanesia	Ore Provinces— 1. General Distribution 2. Ore Provinces in Australia 3. Correlation of O.P. in Australia 4. O.P. in W., N., and S. America 5. O.P. in outlying Islands 6. O.P. in Japan, Formosa, China, &c.	J.M. Anthropology and Ethnology— Decline in Native Population in Islands— 1. Address by Chairman 2. Social Factors 3. Health Factors		
Medical Theatre	Geology Theatre	Physiology Theatre		

X.—SUMMARIZED STATEMENT RE EXCURSIONS.

DIRECTIONS TO MEMBERS.

NOTE.—*Members are requested to read the following as soon as possible after receipt of hand-book :—*

The excursions, as set out below, have been arranged primarily for overseas and Inter-State members attending the Conference. Final arrangements cannot be made until the numbers who wish to take part in the different excursions have been definitely ascertained. Members are therefore requested to decide which excursions they wish to attend, and to notify the Secretary of the Excursions Committee at the Information Bureau (University Union Buildings) as early as possible. It may not be possible to keep the lists open beyond midday on Tuesday, 14th August. No special excursions have been arranged for some of the sections, but members will be provided for as far as possible in the excursions of other sections. Motor cars will be used on several excursions. These cars are being provided by members of the Automobile Club and others, and the Excursions Committee takes this opportunity to thank the owners for their generous help. No provision can be made on these excursions for local members (except as leaders or guides), as the cars are being provided for overseas and Inter-State members only. Provision for the attendance of Victorian members at excursions other than those mentioned above has been made, but in most cases the number will be limited, and names of those wishing to take part in such excursions should be given in as early as possible. Further information as to the features to be observed will be found in the accounts (see below) of the areas to be visited.

The Geology Section is greatly indebted to the Director of the Geological Survey (Mr. W. Baragwanath) for the preparation of the geological maps included in the hand-book.

GENERAL EXCURSION.

Yallourn (Thursday, 16th August).—Open to all members.

Leader.—Sir John Monash, G.C.M.G., etc.

Programme.—Leave Flinders-street Station by special train at 10 a.m. Lunch served in dining-car before arrival at Yallourn. Visit principal points of interest. Leave Yallourn at 5.40 p.m. Dinner served in dining-car. Arrive Flinders-street at 8.50 p.m. Fare (including two meals on train). about £2 2s.

NOTES.—Overseas visitors travel free. Other members may obtain tickets at the Information Bureau (University Union Building). This excursion must be cancelled unless at least 42 members have notified the Secretary of their intention to go, not later than midday on Tuesday, 14th August.

Plan of Melbourne Parks and Botanical Gardens.

(*Wednesday Afternoon, 15th August,* 1923.)

Route of Walk shown by broken line.

VISIT TO MELBOURNE PARKS AND BOTANICAL GARDENS.

At the invitation of the Melbourne University Union Association, members of the Congress will visit the Melbourne Parks and Botanical Gardens on Wednesday afternoon, 15th August. Members will meet at 2 p.m. at the Treasury Gardens (corner of Spring and Flinders streets). The route will be through the Treasury Gardens, Fitzroy Gardens, Yarra Park, across the river (Anderson-street bridge), and through the Botanical Gardens to the Church of England Grammar School, St. Kilda-road, where afternoon tea will be provided.

Members desiring to be present are requested to notify the Secretary of the Excursions Committee at the Information Bureau, University Union Buildings, before midday on Tuesday, 14th August.

SECTION I.—AGRICULTURE.

1. **Lilydale** (Tuesday, 14th August).—Overseas and Inter-State members only.

Leader.—Captain A. E. T. Payne.

Programme.—Leave University by motor car 2 p.m. Inspect stud stock and farm, "Yarra View." Return to Melbourne about 6 p.m.

2. **Werribee Research Farm and Settlement** (Thursday, 16th August). - Overseas and Inter-State members only.

Leaders.—Dr. S. S. Cameron and Mr. A. E. V. Richardson, M.A.

Programme.—Leave Flinders-street south side, opposite Cathedral, by motor car at 9.30 a.m. Inspect Research Farm experimental plots and stock and Werribee Irrigation Settlement. Return to Melbourne about 5.30 p.m.

3. **Western District** (Week-end Excursion—Friday, 17th August, to Monday, 20th August).—Overseas, Inter-State, and limited number of local members.

Leaders.— Mr. A. E. V. Richardson and Mr. R. Crowe.

Programme.—Leave Spencer-street Railway Station 4.45 p.m. Friday, 17th August, for Warrnambool. Arrive 10.52 p.m.

Saturday.—Visit Port Fairy, Koroit, Tower Hill, and Grassmere.

Sunday.—Visit Quamby sheep station.

Monday.—Leave Warrnambool 7.11 a.m. Arrive Melbourne 2.4 p.m.

NOTE.—Tickets for this excursion may be obtained at the Information Bureau, University Union Buildings, University. Fare, £2 12s. 3d.

SECTION II.—ANTHROPOLOGY AND ETHNOLOGY.

1. **National Museum** (Monday, 20th August).—Visit to Australian Ethnological Collection. Open to all members.

Leader.—Professor Sir W. Baldwin Spencer, K.C.M.G., D.Sc., F.R.S.

Meet at Museum, Swanston-street entrance, at 2.30 p.m. Leave not later than 5 p.m.

SECTION III.—BOTANY.

1. **Brighton** (Tuesday, 14th August).—Open to all members.

Leader.—Mr. R. T. Patton, B.Sc., M.F.

Sub-leaders.—Miss E. Derrick, M.Sc., and Miss M. Gordon, B.Sc.

Programme.—Leave Flinders-street Station 2.29 p.m. for Park st., Middle Brighton, *viâ* St. Kilda. Study sand-binding flora. Leave Brighton Beach 5.8 p.m. Arrive Melbourne 5.33 p.m.

2. **Eltham** (Thursday, 16th August).—Open to all members.

Leaders.—Dr. C. S. Sutton and Mr. R. T. Patton, B.Sc., M.F.

Programme.—Leave Prince's-bridge Station for Eltham at 11 a.m. Walk about 6 miles. Study of eucalypts. Lunch for overseas and Inter-State visitors provided. Leave Eltham 4.31. Arrive Melbourne 5.13 p.m.

3. **Sassafras** (Friday, 17th August).—Overseas and Inter-State members only.

Leader.—Mr. Kennon.

Programme.—Leave University 2.15 by motor cars provided by Master Tanners' Association. Visit plantation of exotics at Sassafras. Return Melbourne about 6 p.m.

4. **Marysville** (Week-end Excursion—Saturday and Sunday, 18th and 19th August).—Overseas and Inter-State members only.

Leaders.—Mr. R. T. Patton and Dr. E. McLennan.

Programme.—Saturday : Leave Flinders-street, south side, opposite Cathedral, by motor car 8.30 a.m. Lunch Marysville. Afternoon visit Steavenson Falls. Sleep at Marysville.

Sunday.— Morning: Visit Forest of Arden. Afternoon : Return to Melbourne. Arrive about 6 p.m.

5. **Cheltenham** (Tuesday, 21st August).—Open to all members.

Leader.— Mr. R. T. Patton, B.Sc., M.F.

Sub-leaders.—Miss M. Derrick, M.Sc., and Miss Gordon, B.Sc.

Programme.—Train leaves Flinders-street Station for Cheltenham at 2.8 p.m. Examine flora and scrub association. Leave Cheltenham at 5.10 p.m. Arrive Flinders-street at 5.43 p.m.

SECTION IV.—ENTOMOLOGY.

1. **Agricultural Department** (Tuesday, 14th August). Open to all members.

Leader.—Mr. C. French, jun.

Programme.—Meet at Agricultural Department, Flinders-street Extension (west of Spencer-street), at 2.30 p.m. Inspect economic entomological collection. Leave Department not later than 5 p.m.

Section IV.—Entomology—*continued.*

2. **Macedon** (Thursday, 16th August).—Open to all members.

Leader.—Mr. J. A. Kershaw.

Programme.—Leave Spencer-street Railway Station at 8.30 a.m. Visit Upper Macedon. Leave Macedon 5.53 p.m. Arrive Melbourne 7.22 p.m.

(Tickets for this excursion may be obtained at the Information Bureau, University Union Buildings, University. Fare, 12s. 6d.)

3. **Marysville** (Week-end Excursion—Saturday and Sunday, 18th and 19th August).—Overseas and Inter-State members only.

Leader.—Mr. J. A. Kershaw.

Programme.—See under Botany and Zoology.

4. **Doncaster** (Tuesday, 21st August).—Overseas and Inter-State members only.

Leader.—Mr. C. French, jun.

Programme.—Leave University by motor car at 2.15 p.m. Inspect orchards at Doncaster. Return Melbourne about 6.30 p.m.

SECTION V.—FORESTRY.

1. **Sassafras** (Tuesday, 14th August).—Overseas, Inter-State, and limited number of local members.

Leader.—Assistant-Forester O'Donohue.

Programme.—Leave University by motor car at 2 p.m. Inspect eucalypt forest. Return Melbourne about 6 p.m.

2. **Macedon** (Thursday, 16th August).—Open to all members.

Leader.—Mr. Galbraith.

Programme.—Leave Spencer-street Station at 8.30 a.m. Inspect Mount Macedon nursery and plantation. Leave Macedon 5.53 p.m. Arrive Spencer-street 7.22 p.m.

(Tickets for this excursion may be obtained at the Information Bureau, University Union Buildings, University. Fare, 12s. 6d.)

3. **Creswick** (Week-end Excursion—Friday, 17th August, to Monday, 20th August).—Overseas, Inter-State, and limited number of local members.

Leader.—Mr. Commissioner Code.

Programme.—Friday: Leave Spencer-street at 5.6 p.m. Spend night at Creswick.

Saturday.—Inspect nursery and plantation. Spend night at Creswick.

Sunday.—Motor to Ballarat. Inspect Ballarat gardens and Ballarat Water Commission's plantations. Spend night at Ballarat.

Monday.—Leave Ballarat at 7.43 a.m. Arrive Melbourne 10 a.m.

(Tickets for this excursion may be obtained at the Information Bureau, University Union Buildings, University. Fare, £1 7s. 9d.)

SECTION VI.—GEODESY.

Melbourne Observatory (Tuesday, 14th August).—Open to all members.

Leader.—Dr. J. Baldwin.

Programme.—Meet at Observatory at 2.30 p.m. Inspect instruments and records. Leave not later than 5 p.m.

NOTE.—The number is limited to twenty; but if more than this number desire to take part in the excursion, a second visit will be arranged for Tuesday, 21st August.

SECTIONS VII. AND VIII.—GEOLOGY AND GEOGRAPHY.

1. **Royal Park** (Tuesday, 14th August).—Open to all members.

Leaders.—Professor E. W. Skeats, D.Sc., and Mr. F. Chapman, A.L.S.

Programme.—Leave Geology School 2 p.m. Visit Royal Park cutting and Moonee Ponds Creek. Return to city at about 5.30 p.m.

2. **Werribee Gorge** (Thursday, 16th August).—Overseas and Inter-State members only.

Leaders.—Professor E. W. Skeats, D.Sc., and Assoc. Prof. H. S. Summers, D.Sc.

Programme.—Leave Haymarket corner by motor cars at 8.30 a.m. Run through Bacchus Marsh to Coimadai. Return Bacchus Marsh for lunch. Visit Werribee Gorge. Leave on return about 4 p.m. Arrive Melbourne about 6 p.m.

3. **Studley Park** (Friday, 17th August).—Open to all members.

Leader.—Professor E. W. Skeats, D.Sc.

Programme.—Meet at Victoria-street Bridge at 2.30 p.m. Examine Victoria-street cutting and sections in Studley Park. Return to city about 5.30 p.m.

4. **Macedon and Woodend** (Saturday, 18th August).—Overseas and Inter-State members only.

Leader.—Associate-Professor H. S. Summers, D.Sc.

Programme.—Leave Haymarket corner by motor cars at 8.30 a.m. Visit Upper Macedon and Braemar House (Clyde). Lunch Woodend. Visit Brock's Monument, Hesket, King's Quarry, Hanging Rock, Jim Jim, Sugarloaf, Old Race-course Hill. Dine at Woodend and spend the night there.

5. **Lancefield and Monegeetta** (Sunday, 19th August).—Overseas and Inter-State members only.

Leader.—Professor E. W. Skeats, D.Sc.

Programme.—Leave Woodend 9 a.m. Motor through Rochfort and Lancefield to Mount William (aboriginal quarries). Visit Lancefield graptolite quarry. Lunch Lancefield. Visit railway section at Kilmore Gap. Examine sections on Deep Creek near North Monegeetta. Arrive Melbourne about 6 p.m.

Sections VII. and VII.—Geology and Geography—*continued.*

6. **Yallourn** (Thursday, 16th August).—General.

NOTE.—This is a general and not a sectional excursion, but geologists will visit the points of geological interest under the leadership of Mr. H. Herman, B.C.E., M.M.E. For arrangements see under General Excursions—Yallourn.

SECTION IX.—HYGIENE.

1. **Serum Institute** (Tuesday, 14th August).—Open to all members.

Meet at Serum Institute at 2.30 p.m. (See Excusion Pamphlet *re* routes.)

2. **Werribee Sewage Farm** (Tuesday, 21st August).—Overseas and Inter-State members only.

By Motor-car. Time and place of departure will be announced later.

SECTION X.—VETERINARY SCIENCE.

1. **Serum Institute** (Tuesday, 14th August).—See under Hygiene. Or Lilydale.—See under Agriculture.

2. **Werribee Research Farm** (Thursday, 16th August).—See under Agriculture.

3. **Western District** (Week-end Excursion—Friday, 17th August, to Monday, 20th August).—See under Agriculture.

SECTION XI.—ZOOLOGY.

1. **National Museum** (Tuesday, 14th August).—Open to all members.

Leader.—Sir W. Baldwin Spencer, D.Sc., F.R.S., &c.

Programme.—Meet at Swanston-street entrance of Public Library at 2.30 p.m. Inspect zoological specimens in Museum. Leave Museum not later than 5 p.m.

Thursday, 16th August.

No special excursion arranged, but members may take part in the excursion to Eltham (see under Botany) or to Warburton (see under Forestry).

2. **Healesville and Marysville** (Week-end Excursion—Saturday and Sunday 18th and 19th August).—Overseas and Inter-State members only.

Leaders.—Healesville: Dr. Colin Mackenzie. Marysville: Mr. Kershaw.

Programme.—Saturday: Leave Flinders-street, south side, opposite Cathedral, at 8.30 a.m. Inspect the native fauna at the Healesville Research Reservation. Arrive Marysville about 6 p.m.

Sunday.—See under Botany.

3. **Zoological Gardens** (Tuesday, 21st August).—Open to all members.

Leader.—Mr. W. H. D. Le Soeuf.

Programme.—Meet at entrance gate to the Zoo at 2.30 p.m. Leave gardens not later than 5 p.m.

XI.—EXCURSION PAMPHLETS.

SECTION I.—AGRICULTURE.

1. EXCURSION TO " YARRA VIEW " STUD FARM, LILYDALE.

(*Tuesday, 14th August,* 1923.)

The Yarra View Stud Farm, situated in the valley of the River Yarra, 5 miles from Lilydale, and about 25 miles from the G.P.O., Melbourne, is recognised as one of the foremost stock-breeding establishments in the State.

Its founder and owner, Captain A. E. T. Payne, has imported some of the best Guernsey cattle, Romney Marsh sheep, and Berkshire pigs that have been brought to Australia.

During the seventeen years since its establishment, the Yarra View Stud Farm has been singularly successful, both from the breeding and the show ring stand-point. Innumerable distinctions have been gained by Yarra View stock at the principal exhibitions in the Commonwealth.

The Guernsey herd was founded in 1910 by the importation from England of seven cows, specially selected for their dairying qualities, and in calf to unrelated bulls ; also the stud bull " Trengwainton Acorn," whose dam " Haye's Olive " was the champion cow of England, with nineteen first prizes to her credit, including the premier award at London Dairy Show in the milking trials. Other importations include the stud bull " Royal Sequel 2nd," a great prize winner and a noted sire of high-producing females. The average test of the herd is now 6.2 per cent. butter fat.

The Romney Marsh flock has been built up on pure Elham blood, rams and ewes being imported direct from the flock of the late Mr. Charles File, of Elham, Kent (England).

Included in the former are " Elham 45 of 1906 " (Champion of England), " Elham 15 of 1906," " Elham 112 of 1910 " (Champion of England), " Elham 25 of 1911," " Elham 53 of 1911," and " Elham 13 of 1912."

By strictly adhering to one line of breeding, and by careful and judicious mating, Captain Payne has succeeded in establishing an even type of sheep, possessing the best characteristics of the breed.

Three hundred and forty-seven awards have been won by this flock since 1910, and sheep sold to South America, South Africa, New Zealand, Tasmania, and every State of the Commonwealth have been successful in the show ring. The flock now numbers upwards of 300 breeding ewes.

The foundation of the Berkshire stud dates back to 1907. It consists of English importations and their descendants.

A Clydesdale stud was formed three years ago by the purchase of several noted mares, viz. :—Lady Margaret (imp.), by Baron Ruby, ex Isobel ; Grace of Craigwillie (imp.), by Everlasting, ex Gem of Craigwillie ; Scotch Lassie, by The Admiral (imp.), ex Royal Midget ; Meg of Bolobek, by Shanter (imp.), ex Lady Margaret (imp.) ; Vera Douglas, by Douglas Chief, ex Sweet Nell ; Rosaneath White Silk, by Baron Wighton (imp.), ex Flora ; and the stallion Benmore, by Dalmore (imp.), ex Scotch Lassie.

Improvement of Pastures.

In its natural state the carrying capacity of the Yarra View country is one and a half sheep per acre. The stock-carrying capacity has been greatly increased by top-dressing and the sowing down of grasses. Victorian soils are naturally deficient in phosphoric acid, and in many districts the very limited supplies of phosphate have been depleted by the continuous removal of phosphates by the grazing of animals. In addition to the shortage of phosphates, the fertility of the heavier rainfall country has been further depleted by the leaching of nitrates and particularly of lime. Of the 30,000,000 acres of pasture land in Victoria over 60 per cent. has a rainfall exceeding 20 inches.

The problem that confronts land-owners is how the pastures can best be re-established and maintained at a high state of efficiency. In country similar to Yarra View it appears that the best method is to break up the land, apply lime, sow a mixture of grass seeds, and top-dress occasionally with phosphatic manure.

A striking illustration of the manner in which the soil responds to such treatment may be seen on the Yarra View Farm. The natural herbage consists of poor unnutritious indigenous plants, which carry one and a half sheep per acre. Where land has been broken up and seeded with a mixture of clovers and grasses, the stock-carrying capacity has been trebled. Of the total area of 980 acres 450 acres have been sown with English grasses. The mixture of grasses generally used comprises the following :—Perennial rye, 15 lbs. ; cocksfoot, 8 lbs. ; Italian rye grass, 5 lbs. ; Alsike clover, 4 lbs. ; cowgrass, 2 lbs. In the case of high land 1 lb. of Subterranean clover is added to the mixture. The growth of Subterranean clover (*Trifolium subterraneum*) on the higher lands of the property has been remarkable, and has resulted in a marked improvement in the stock-carrying capacity of the land.

2. EXCURSION TO THE STATE RESEARCH FARM, WERRIBEE, AND THE WERRIBEE IRRIGATION SETTLEMENT.

(*Thursday, 16th August,* 1923.)

State Research Farm, Werribee.

The State Research Farm was established to provide, for permanent use by the Department of Agriculture, a farm on which to carry out research work, experiments, and practical demonstrations in all branches of agriculture and live stock husbandry.

The work carried out reflects the teachings and experience of the staff of the Department, and is designed to insure in its results the promotion of sound and advanced agricultural practice suitable to the present and probable future circumstances of the State.

The purpose of the farm is not to attain financially profitable results so far as the farm itself is concerned, but to confer on agriculture the benefits of modern scientific advances by the prosecution of investigations and trials under practical and accurately recorded conditions concerning the problems involved in increasing the agricultural output of the State, particularly as regards—

(*a*) Improvements of wheat and other cereals, grasses, and economic plants by selection and hybridization.

(*b*) Soil renovation, fertilizing and tillage methods.

(*c*) Rotation of crops and improved cropping practices.

(*d*) Irrigated crops—the effect of variation in water supply, fertilizers, and cultural methods on yield and quality of irrigated lucerne.

(*e*) Improvement of natural pastures, and trials of artificial grassing with exotic and native grasses.

(*f*) The breeding and feeding of live stock and improvement of milk yields.

(*g*) Research concerning soil moisture, temperatures, biological conditions, and nitrification processes ; and the nutrition of plants.

(*h*) Meteorological observations relating to agriculture.

The location has many advantages. Among them is the proximity of the area to Melbourne (18 miles), whereby close touch by the Department is facilitated, and easy access by farmers from all parts of the State is afforded. The proximity to Werribee Railway Station (1 mile), the long stretch of observation obtainable from the railway and Geelong-road, the fact that both dry farming and irrigation areas are in proper proportion, and also that comparatively good land and definitely poor land are included, are combined advantages that could not be secured elsewhere in the State. Much of the soil closely resembles in physical character and chemical analysis that of the Goulburn Valley and Wimmera cereal-growing districts.

The area of the farm is 2,211 acres, of which approximately 75 per cent. is soil of poor to fair quality (shallow red basaltic loam resting on a stiff-clay subsoil), the balance comprising good volcanic loam and alluvial soil. Some 350 acres of the latter land is irrigated and sown with lucerne, mixed grasses, or fodder crops.

Experimental Work.

The main object of the field experiments is the determination of the most suitable types of crop rotation for a district of medium rainfall, types and quantities of fertilizers necessary to give the maximum net profit per acre, and the cultural practices most suitable for the profitable growth of the various cereal crops raised in Victoria.

On the irrigated portion experiments are being conducted to determine the effect of varying quantities of water required for various irrigated crops, the influence of fertilizers on crop yields, and the best methods of maintaining continuous heavy yields of lucerne.

Attention has been directed to the improvement of cereal crops by selection and hybridization, and many new and promising cross-bred wheats are now undergoing final trials at selected centres throughout the wheat belt prior to being distributed to growers.

The area devoted to field investigations comprises 152 acres, made up as follows :—

Permanent Rotation Tests	18	acres
Cereal Breeding Investigations	16	,,
Green Manurial and Feeding-off Tests	20	,,
Permanent Fertilizer Tests	14	,,
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Full details of these various investigations will be supplied in a special Guide-book supplied by the Department of Agriculture.

Live Stock.

The average number of live stock maintained on the farm is as follows :— Sheep, 1,200 ; dairy cattle, 160 ; horses, 90 ; poultry, 1,200.

The whole of the food used for their maintenance, with the exception of bran for dairy cattle, is produced on the farm.

Cattle.—The dairy herd and red-polled cattle was established by the Department thirteen years ago. The natural pasture land of the farm is not suited for dairying, but with the irrigation produce, silage, and conserved fodders satisfactory returns have been obtained from the dairy herd.

The Friesian herd of 25 head was established at Werribee in 1919. The foundation stock of this herd was obtained from the New Zealand Government. Friesians are generally recognised to be heavy milking cattle, and this fact has been verified by those already tested at Werribee.

Horses.—The majority of the working horses on the farm are pedigreed Clydesdales. The stud sire at present in use is " Baron Wigton," imp. (C.S.B. No. 13884), a very typical Clydesdale that has not only won many championships in New Zealand, but also is the sire of many first-class stallions in use throughout New Zealand and the Australian States.

The farm has been fortunate in possessing the two famous Clydesdale brood mares Patricia (N.Z. C.S.B., 1604) and Lucilla (N.Z. C.S.B., 1605). Patricia has a rare winning record, and was champion of Melbourne Royal Show in 1917 and 1918. Lucilla has also a long winning career in New Zealand, and has secured honours in brood mare classes at the Melbourne Royal Show.

Sheep.—Border Leicesters.—Quite a notable collection, both as regards numbers and quality, of Border Leicesters have been got together during the last four years. The studs drawn upon for the establishment of the flock are those of Mr. D. M. Sutherland, Waimati, New Zealand ; Lake Midgeow Estate, New South Wales ; and Mr. John Sutherland, Lara, Victoria.

The quality of the stud may be gauged by the fact that it includes winners of championships at Christchurch, New Zealand, and the Sydney and Melbourne Sheep Breeders' Shows. The flock now numbers 250.

Suffolks.—A Suffolk stud comprising 200 sheep has been established at Werribee. This stud has been very successful at the Melbourne Sheep Breeders' Show and the Annual Show of the Royal Agricultural Society.

The chief features of the breed are early maturity and prolificacy. The average lambing for the stud ewes of this flock for the past seven years has been 160 per cent.

Werribee Irrigation Settlement.

The Werribee Irrigation District comprises an area of 8,121 acres, situated along the eastern bank of the Werribee River, between the Melbourne–Ballarat railway line and Port Phillip Bay.

The water supply of the district is obtained from the Werribee River by a gravitation system, the water being conserved at the Melton Reservoir, which has a capacity of 17,000 acre-feet.

The greater part of the area is contained in the Werribee Closer Settlement Estate, which was purchased by the State for subdivision and sale under extended terms. This is divided into 238 holdings of an average area of about 40 acres.

The principal crop in the area is lucerne, to which over 4,000 acres are sown. The remainder of the area is used for cereal crops. orchards, and vegetable-growing. The area devoted to the latter two is extending each year as settlement increases.

Lucerne and cereal growing for hay are the chief pursuits in the district, as on account of the nearness to Melbourne there is always a good market for green lucerne, hay, and chaff. In addition, dairying is carried on to some extent, the total number of cows in the district being approximately 1,000. The milk is treated at a Settlers' Co-operative Factory, and is either pasteurized and sold in Melbourne as market milk or is used for butter-making.

The soils are similar to those on the Werribee Research Farm, which have already been described.

The average duty of irrigation water in the district is approximately 1 foot, but it is anticipated that in the future, as larger areas are brought under lucerne, this will be increased to at least 2 feet.

3. EXCURSION TO WESTERN DISTRICT.

(*Friday, 17th August, to Monday, 20th August*, 1923.)

Excursion to Warrnambool, Tower Hill, Port Fairy and District, and Quamby Sheep Station.

The Western District of Victoria is noted for the production of fine-woolled merino sheep, dairy products, cereals and hay, and root crops. The rainfall varies from 20 to 35 inches.

A considerable proportion of the Western District is included in the "newer volcanic" region. The general aspect of the newer volcanic region is a fairly level plain, with rounded or conical hills at frequent intervals.

In the Western District the volcanic region has an average elevation of about 400 feet above sea-level, and it gradually rises to a height of 1,200 to 2,000 feet as it ascends the slope of the Main Divide.

The areas which it is proposed to visit comprise some of the richest lands in Australia. Large tracts of land extending from Port Fairy, Warrnambool, Camperdown, and Colac are uniformly rich in character. The soils are deep, and contain large amounts of organic matter and a sufficiency of carbonate of lime to make them exceedingly friable.

Speaking as a whole, the volcanic soils are greatly modified in value by the proportion of rock present and its proximity to the surface. There are some areas, *e.g.*, the stony rises to the west of Colac, where the rock is very close to the surface. At Koroit there are examples of black and chocolate soil superimposed on mudrock and ashes 50 to 100 feet in depth ; while over very large areas, though rocks are met with, the characteristic appearance of the soil is yellow or grey loam intermixed with buckshot, *i.e.*, small rounded particles of ironstone. On these latter areas cereals and hay are grown, or the land is used for the grazing of sheep. On the richer areas intensive agriculture and dairying are practised.

The country between Melbourne and Geelong is a level plain, and Werribee, 20 miles distant from Melbourne, is the principal place of interest *en route*.

The State Research Farm is situated at Werribee. A large area of land adjoining the town is irrigated from water impounded in the Exford Reservoir, which has a capacity of 17,000 acre-feet.

Further out, south from Werribee township and running to Port Phillip Bay, is the Melbourne and Metropolitan Board of Works Sewerage Farm. The whole of the metropolitan sewage is used on this farm for irrigation purposes, and large numbers of cattle and sheep are fattened on grasses raised on the farm.

The country between Werribee and Geelong is occupied by farmers engaged chiefly in hay and barley growing. The average rainfall of the Melbourne-Geelong plain varies from 20 to 25 inches.

At Geelong there are two freezing works, the larger of which was erected by the Geelong Harbor Trust, and leased to the exporting firm of Sims, Cooper, & Co.

There are also a number of woollen mills, including the Commonwealth Government Mills, which were recently sold. The Commonwealth Mills during the war manufactured most of the clothing required for soldiers' use.

Between Geelong and Birregurra, a distance of 40 miles, nearly the whole of the country was until about fifteen years ago regarded as being very poor. Now, with the use of phosphatic manures and bare fallowing, heavy hay crops are grown.

Between Birregurra and Colac the land is of better quality. The line skirts Lake Colac on the south, whilst the best land (some of which sells up to £100 per acre) is on the north side of the lake, commencing about 5 miles out of the town.

Up till about 30 years ago most of the country was owned by squatters, who used it for sheep and cattle raising. The annual stud stock sales at Robertson's attracted buyers from all over Australasia ; but, with the advent of dairying and potato and onion growing it was subdivided and sold to farmers. The whole of the country is now closely settled.

The Colac Dairying Company is the largest in the State, and manufactures butter, cheese, casein, lactose, and other milk products. The Colac Dairying Company distributes annually £540,000 amongst suppliers. Large areas of potatoes and onions are grown in this district.

From Colac to Camperdown (a distance of 28 miles) the railway runs through the Stony rises, of basaltic formation. There are interspersed areas of rich soil, which provide good autumn and winter feed for stock.

The history of the Camperdown and Terang district (14 miles further on) is the same as Colac, and was originally settled by squatters occupying large areas, which have gradually been subdivided and occupied by small settlers, chiefly dairymen.

The land was in the first instance farmed on the share system. The usual arrangement made under the share-farming agreement was: The land-owner or squatter provided the land, buildings, implements, and equipment, also the necessary cows. The share-farmer supplied all the labour and received one-third

of the annual proceeds. Under this system of share tenancy the value of the land rapidly advanced, and most of it was ultimately purchased by those who were originally share tenants—all of whom are now independent.

There is a large butter factory at Camperdown, and one further out at Cobden, 8 miles south. These factories produce butter, cheese, casein, and dried milk products.

At Glenormiston (6 miles north of Terang) the Trufood Company produces dried milk. The factory premises were originally a bluestone woolshed, which was converted into a butter factory, and subsequently a dried milk factory.

There is a large butter factory at Noorat (four miles north of Terang).

The land between Terang and Warrnambool is mostly second class land used for dairying and stock-raising. During recent years the stock-carrying capacity of this land has greatly increased by the use of superphosphate as a top dressing. By this means the growth of grass has been greatly increased and the palatability and quality of the grass has been materially improved.

The City of Warrnambool is built on lime sandstone formation, and nearly all of the buildings are constructed of sandstone which was taken out in huge slabs a couple of tons in weight and sawn into building blocks with a crosscut saw.

This sandstone hardens with exposure, but in consequence of the porous nature of the stone, for dwellings a cementing on the outside is necessary to exclude moisture.

Between Warrnambool and Port Fairy (a distance of 18 miles) lies some of the richest country in Australia.

Tower Hill, located midway, is an extinct volcano, with Koroit situated on the north side.

Tower Hill is regarded as one of the most recent evidences of volcanic action in Australia, and from road cuttings passed through, and also from wells sunk in the neighbourhood, it is evident that the volcano vomited huge quantities of volcanic ash and scoria alternately, which are distributed for miles round in every direction. It would appear that originally it had a formation like an inerted spinning top, similar to Mount Egmont in the Taranaki district of New Zealand. There were times when huge bombs weighing from 5 cwt. to a ton were blown high into the air and splashed into the scoria a distance away. This is evidenced by the large clinkers found in excavations, surrounded by white ash, and covered with subsequent lava flow. Ultimately the core became choked, the pressure increased until the top was completely blown away, leaving a crater of about 2 miles in diameter, with only the base showing. The islands of about 1,000 acres in the centre are the result of subsequent volcanic action.

This theory of the top having been blown away is supported by an examination of the edges all round, which show the layers ending abruptly without any sign of inward dip. Had the cavity been formed by subsidence the layers of soft cement stone alternating with scoria would dip inwards.

At Dennington (3 miles out of Warrnambool) Nestlé's Condensory is situated on the Merri River. This is reputed to be the largest milk condensory in the world, and in the height of last season treated up to 47,000 gallons of milk per day.

Near Port Fairy the Glaxo Company have a large factory, where the well-known infants' food is produced. To this factory has recently been added a large Cheese Factory. There is also a Butter Factory at Port Fairy, another at Koroit, and a third at Grassmere.

Not including Nestlé's, Glaxo Pty., and private butter and cheese factories, the value of butter, cheese, and milk products manufactured by co-operative butter factories in the Western District this year was approximately £1,814,000.

Originally this rich country was used for potato-growing, and up to 30,000 tons used to be shipped yearly from Warrnambool. Now dairying is the chief industry.

The Quamby Sheep Station (20 miles from Warrnambool) has an area of approximately 25,000 acres, and carries over 20,000 sheep, mostly fine-wool types, and numerous cattle. Visitors will be able to see the homestead, improvements, and stock of a typical Western District sheep station. A feature of interest for overseas visitors is that over 2,000 kangaroos run at large on portion of the Quamby Station.

SECTION 3.—BOTANY.

1. EXCURSION TO BRIGHTON.

(*Tuesday*, 14*th August*, 1923.)

Sand-binding Flora of Brighton Beach.

By R. T. Patton, B.Sc., M.F., D.I.C., F.R.H.S.

The land on which these plants grow has been naturally reclaimed from the sea. The rocky points at the north and south ends of the sandy stretch, combined with the set of the tide, have been the cause of the reclamation. The tide comes in at an acute angle to the beach, and carries with it along the shore all detritus from the southern point. The northern point acts as a barrier and the transported material cannot be carried further.

The present flora is typically xerophytic so far as the perennials are concerned. These are the true sand binders. In the spring there is, in addition, a large number of annuals, particularly grasses, which disappear as soon as the hot weather sets in. The hot weather coincides with the driest conditions in the soil. This dryness is due, not to any serious deficiency in the monthly rainfall, but to increased evaporation.

The chief perennials of the formation are native species; but there are, scattered throughout, a number of exotics, mainly from South Africa.

The dominant plant throughout the area is the coastal tea-tree *Leptospermum lævigatum*. This forms a dense scrub, with a very close canopy. The ground beneath may be devoid of vegetation. The trees are never tall, but may, in sheltered places, approach 30 feet in height. The stems are characteristically tortuous and deeply furrowed, and the bark is papery and readily peels off. This is due to the presence of bands of thin walled parenchyma formed at intervals in the phlœm.

The leaves of tea-tree are well protected with thick cuticle. The stomata are fairly large, and the number per sq. mm. varies from 120–140. The leaf is isobilateral, and the two palisade layers almost meet at the centre, leaving only a small development of mesophyll between. There is no hypodermis, but the cuticle is 6–10 μ in thickness.

Next in abundance to the tea-tree is the coast wattle, *Acacia longifolia*. The phyllodes are coriaceous and very tough. They are isobilateral, and the cuticle is from 10–16 μ in thickness, being equal to or greater than the cavity of the epidermal cells. Stomata are found on both surfaces, and number from 140–150 per sq. mm. The mesophyll is very well developed and resembles a pith, being greater in thickness than the two layers of palisade cells together. The pith-like mesophyll is devoid of chlorophyll. This plant is a very abundant seeder; but, owing to lack of moisture in the soil and the

impermeability of the seed coat, young plants are not frequently found. These trees are frequently disfigured, owing to attacks by gall-forming insects. On the phyllodes may be seen brown circular raised spots, which are due to the presence of perithecia of the *Ascomycete, Trabutia phylloidiæ.*

The third most important tree is the wind-stay bush, *Myoporum insulare* (N.O. *Myoporineæ*). The bark is thick and has a tesselated appearance. Although it flowers freely, this tree does not appear to set much seed. Small dark-raised areas on the leaves are galls containing larvæ of an hymenopterous insect and a fungus. It is not certain whether this is a symbiotic or a parasitic relationship between the insect and the fungus. The trees, however, do not appear to suffer from the combined parasitism. The leaves are more succulent than those of the other trees here, but the cuticle is not so strongly marked. The internal structure of the leaf is comparable with that of tea-tree, the mesophyll being poorly developed.

Among other trees to be found are *Casuarina stricta* (N.O. *Casuarineæ*). These occur occasionally wherever this flora is found, but they are more frequently seen on the basalt plains where other trees are not common. Along the beach they may be regarded as intruders. They are in this flora, but not necessarily of it.

A tree usually found in this association, and the absence of which is surprising, is the coast honeysuckle, *Banksia integrifolia* (N.O. *Proteaceæ*). It is to be found from Sandringham on to the ocean beaches. This is the tallest of the coastal trees.

An important associate of the trees is the climber "Travellers' joy," *Clematis microphylla* (N.O. *Ranunculaceæ*). Another climber found here is the Cape Ivy, *Senecio scandens* (N.O. *Compositæ*), introduced from South Africa.

Only one tall native shrub is present, the coast daisy, *Olearia axillaris* (N.O. *Compositæ*). The leaves are small, dorsiventral, and the under side is protected by a dense felt of cottony hairs. Like the associated trees, this shrub shows abundant development of leaves.

There is another shrub belonging to N.O. *Compositæ, Osteospermum moniliferum*, the jungle sunflower, which is introduced from South Africa. It differs from the typical composite in possessing succulent fruits. The leaves are large, like those of a mesophyte, but when young have a cottony vestiture. This plant is not confined to this sandy belt, but is scattered over a very wide area. Its presence here is due to its adaptability rather than to any specialization.

Both of these composites are very compact plants and resist wind action by their close branching.

The most plentiful of the undershrubs is *Rhagodia Billardieri* (N.O. *Chenopodiaceæ*). Under the dense shade of the tea-tree it assumes a much more upright habit than when growing in exposed positions. This plant is a

rudimentary sand binder, since its straggling habit does prevent the sand from moving. The prostrate branches root at long intervals and thus bind the sand.

Another member of N.O. *Chenopodiaceæ* is to be found at rare intervals, but never far from the shore. It is most probably present as a halophyte, not as a sand binder. It is the mealy salt bush—*Atriplex cinerea*.

The surface plants are the true sand binders, and the most important of these are *Spinifex hirsutus* (N.O. *Gramineæ*) and the native spinach, *Tetragonia expansa* (N.O. *Ficoideæ*). The former sends out very long runners or rhizomes, which root at the nodes. These rhizomes have been found up to 12 feet in length. The species is diœcious, and both male and female plant are gregarious. Although flowers are plentiful, very few, if any, are fertile. Hence the plant does not spread rapidly. When mature the large spherical inflorescences become detached and, blown by the wind, roll along the sand.

In a transverse section of the rhizome a band of sclerenchyma is seen near the surface. Some bundles are embedded in this band, but the majority lie within it. The leaves are grooved on the upper surface and bear long appressed hairs on the under side. Stomata are found on both sides.

The well-known marram grass, *Psamma arenaria*, has been planted here. This does not appear to be as suitable as spinifex, and does not produce fertile seed. The edges of the leaves are inrolled, making them appear cylindrical. The stomata are all on the inner side in cavities.

The spinach, *Tetragonia expansa*, has succulent leaves, which are sometimes used as a vegetable. The runners are long and slender, and bear, at frequent intervals, the leaves which lie flat on the ground. It is one of the few succulent herbs among these xerophytes. The peculiar appearance of the leaf surface is due to the presence of semiglobular, epidermal cells, which are distended with sap. Other *Ficoideæ* present are two species of mesembrianthemum (pig face), *M. equilaterale*, with large yellow flowers and decussate leaves triangular in section, and the South African species *M. tegens*, which has small pink flowers. The small greyish cylindrical leaves, about ½ inch long, are covered with large distended epidermal cells like those on leaves of *Tetragonia expansa*.

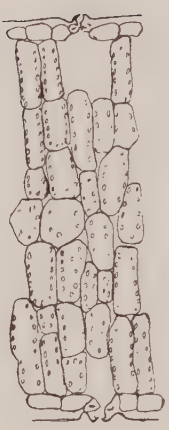
The formation, although strongly xerophytic, is characterized by the density of the crown canopy in contrast to the usually open nature of xerophytic ones. This undoubtedly shelters the soil from the strong summer sun. The principal trees of the formation have several common features. They never attain any great dimensions, are more or less gnarled, and, with the exception of casuarina, are all densely foliated with rather small leaves.

These trees cannot strictly be called sand binders since they do not bind the soil, but owing to the densely-developed crowns they prevent the wind reaching the sandy surface and so attain the same result. The heavy canopy also prevents excessive evaporation from the soil, and the damper the sand the less the danger of drifting.

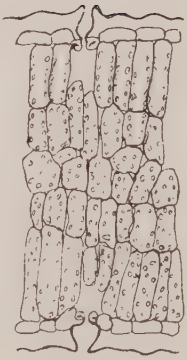
In the following table are given some percentages of leaves only which have been averaged from a large number of examinations of this flora :—

Species.	Percentage of Water calculated to green weight.	Percentage of Ash calculated to dry weight.	Percentage of Ash calculated to amount of water present.
Leptospermum laevigatum ..	48·5	3·5	3·7
Acacia longifolia	64·6	4·3	2·4
Myoporum insulare ..	70·5	15·1	6·3
Rhagodia Billardieri ..	87·6	28·6	4·0
Tetragonia expansa ..	90·7	9·3	3·1

Acacia longifolia.

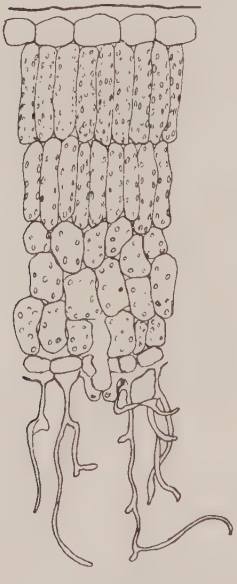


Myoporum insulare.



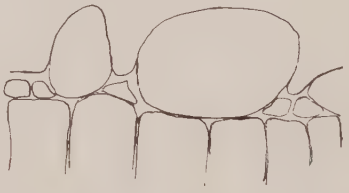
Leptospermum laevigatum.

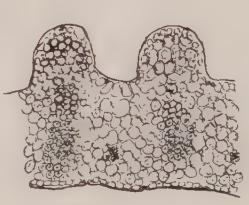
Olearia axillaris.



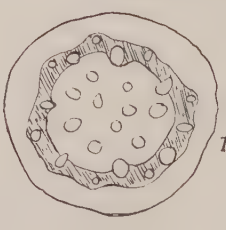
Rhagodia Billardieri.

Tetragonia expansa.





Spinifex hirsutus.



T.S. RHIZOME.

SECTIONS OF LEAVES
BRIGHTON BEACH.

2. EXCURSION TO ELTHAM.

(*Thursday*, 16*th August*, 1923.)

Notes on the Eucalypts of Eltham.

By R. T. Patton, B.Sc., M.F.

Form.—Erect (*E. rubida*), inclined (at times), *E. rostrata*, long boled (*E. rubida*), short boled (*E. elæophora*).

Habitat.—Rocky (*E. macrorrhyncha*), sandy (*E. viminalis*) (one variety), Swamp (E. *ovata*).

Bark.—Persistent (*E. elæophora*), deciduous (*E. rostrata*), fibrous (*E. macrorrhyncha*), compact (*E. polyanthemos*).

Leaves mature.—Falcate (*E. viminalis*), ovate (*E. ovata*), asymmetric (*E. elæophora*), almost symmetric (*E. coriacea*).

Leaves juvenile.—Orbicular (*E. rubida*), lanceolate (*E. viminalis*), glaucous (*E. elæophora*), non-glaucous (*E. viminalis*).

Inflorescence.—Umbel (*E. amygdalina*), panicle (*E. polyanthemos*).

Buds.—Sessile (*E. elæophora*), stalked (*E. rostrata*), operculum domed (*E. melliodora*), beaked (*E. rostrata*).

Peduncle.—Cylindrical (*E. melliodora*), flattened (*E. elæophora*).

Stamens.—All fertile (*E. viminalis*), outer sterile (*polyanthemos*).

Anthers.—Lobes parallel (*E. viminalis*), reniform (*E. amygdalina*).

Fruit.—Lemispheric (*E. amygdalina*), conical (*E. ovata*), valves exsert (*E. rostrata*), enclosed (*E. coriacea*).

Brief description of Species.

Gums.—Smooth bark more or less whitish, leaves equally green on either side, drooping, inflorescence axillary or extra-axillary solitary, stamens infolded, all fertile, anther lobes parallel, except *E. coriacea*, debiscing by slits.

Swamp Gum.—*E. ovata* (Labill).—Never tall, bole poorly defined, branching low down, mature leaves ovate to ovate lanceolate, often waved, lateral veins spreading, intramarginal vein distant from edge, juvenile leaves broadly ovate to orbicular. Umbels, buds several, almost sessile, operculum bluntly pointed, rim well-defined slightly domed valves about level with rim.

Indicative of wet ground.

Candle Bark Gum.—*E. rubida* (Deane and Maiden).—Moderately tall, clear bole, often distinctive with bright blotches of colour, mature leaves lanceolate, falcate, lateral veins spreading, intramarginal veins moderately distant from edge. Juvenile leaves opposite, sessile, orbicular, glaucous, often emarginate. Umbels, buds three, cruciform, almost sessile, fruit more or less hemispheric, rim broad, valves exsert.

Higher ground indicative of fairly dry condition.

White Gum.—*E. viminatis* (Labill).—Very similar to *E. rubida* but differing as follows:—Bole never brightly blotched, juvenile leaves opposite sessile, lanceolate, not glaucous, often reddish.

Usually found in valley floors where soil is damp but ærated.

Red Gum.—*E. rostrata* (Schlecht).—Moderately tall, bole varies according to locality, lateral veins spreading, intramarginal veins moderately removed from edge, buds, several in umbel, conspicuously stalked, operculum beaked, slightly longer than calyx tube, fruit hemispheric, rim broad, convex, valves exsert.

Indicative of cold, wet ground, at least for portion of the year.

Forest Red Gum.—*E. tereticornis* (Smith).—Similar to *E. rostrata* but differing in the following:—Juvenile leaves broader, operculum elongated, conical 3-4 times longer than calyx tube, membranous, stamens not all inflexed.

On river flats.

Snow Gum.—*E. coriacea* (A. Cunn).—Fairly tall, mature leaves coriaceous, elliptical to lanceolate, slightly or not at all falcate, veins longitudinal distinct, umbel many flowered, buds almost sessile, anthers reniform, fruit truncate ovate, orifice contracted slightly, rim flat or slightly domed, valves enclosed.

Grows right up to timber line.

Peppermint Group.—Bark compact (not as much as Box), somewhat flaky, persistent on trunk, mature leaves with copious oil dots, lateral veins very oblique, intramarginal vein distantly removed from edge, juvenile leaves opposite, sessile, lanceolate. Umbels axillary or extra-axillary solitary, buds very numerous up to 20, peduncle cylindrical, stamens infolded, anthers reniform, fruit small almost globular, rim flat, rather broad, valves about level with the rim.

Peppermint.—*E. amygdalina* (Labill).—Medium tree, bole more or less distinct, mature leaves lanceolate, thin, bark persistent on the branches.

If leaves be crushed the oil will be seen to exude. Commonly used for distillation of Eucalyptus oil.

Indicative of very poor conditions.

White Top Gum.—*E. vitrea* (R. T. Baker).—Taller than peppermint, upper branches smooth like a gum, mature leaves larger than those of *E. amygdalina*, lateral veins also much more oblique.

Box Group.—Never tall like the gums, inhabiting regions of lower rainfall, persistent, leaves drooping, equally green on both sides.

Long Leaved Box.—*E. elæophora* (F. v. M.).—Not a timber tree, never forming a distinct bole, petiole long, intramarginal vein remote, juvenile leaves orbicular to ovate, sessile, umbel with four to seven buds, buds sessile, anthers opening by parallel slits, peduncle short flattened, fruits slightly angular, valves enclosed or level with the rim.

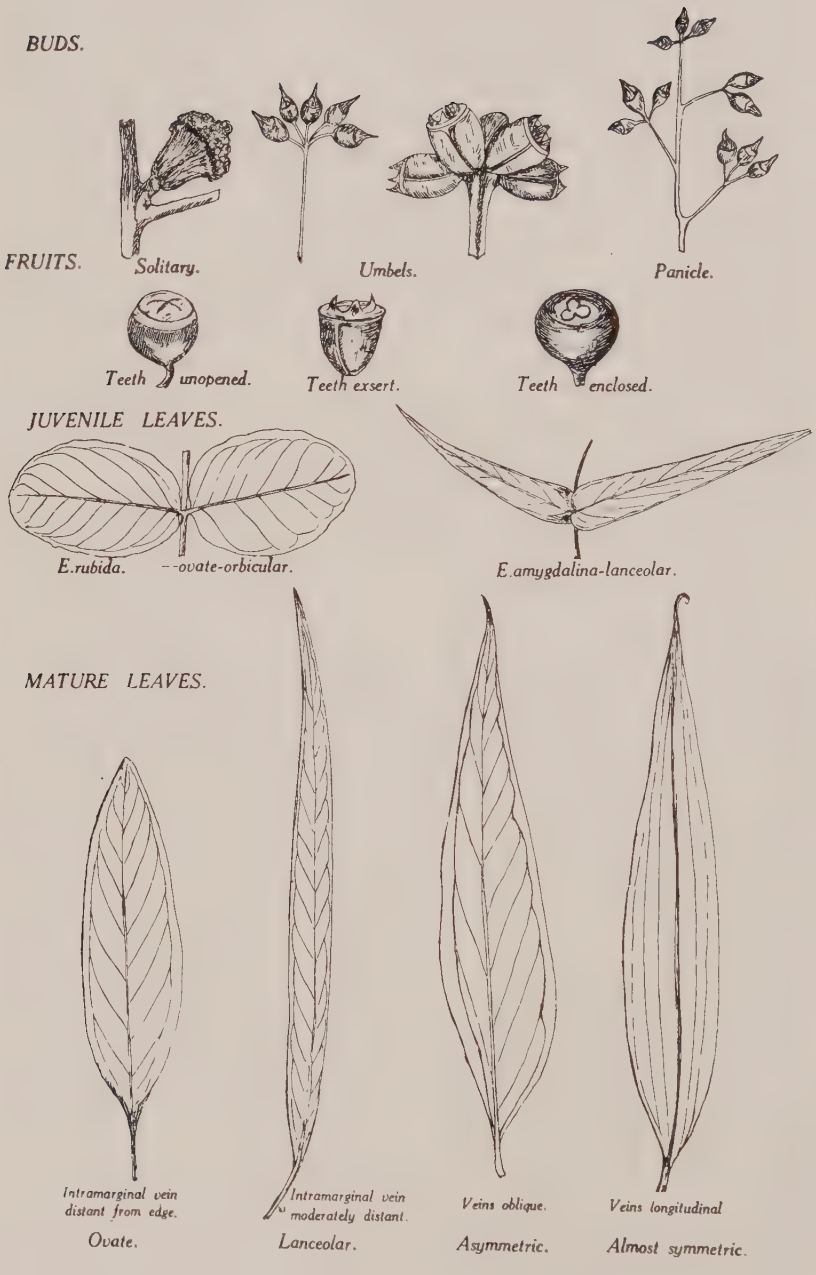
Red Box.—*E. polyanthemos* (Schauer).—Very spreading tree, bole poorly developed, mature leaves, broad, orbicular to ovate, glaucous, juvenile leaves much broader than long, inflorescence a panicle, outer stamens sterile, anthers opening by pores, fruit conical, teeth enclosed.

Yellow Box.—*E. melliodora* (A. Cunn).—Tall, mature leaves, narrow lanceolate, intramarginal veins distantly removed from edge, juvenile leaves ovate, umbels (3–8 flowers) solitary or slightly paniculate, anthers opening by pores, fruit semi-ovate, rim very distinct, broad, easily breaking away.

Stringy Bark Group.—Usually form a good bole, bark very stringy or fibrous, leaves falcate, often markedly symmetric, coriaceous, inflorescence, umbels axillary or extra-axillary, stamens all fertile, inflexed, anthers reniform. Usually growing in hilly or stony country. Indicative of some unfavorable soil factor.

Red Stringy Bark.—*E. macrorrhyncha* (F. v. M.).—Moderately tall, leaves thick, operculum as long as the calyx, concave conical, buds very definitely stalked, fruit lower part hemispheric, rim very broad, teeth prominently exsert.

Literature.—*Critical Revision of the Eucalypts*, by J. H. Maiden, F.R.S.


BUDS.
FRUITS.
Solitary.
Umbels.
Panicle.
Teeth unopened.
Teeth exsert.
Teeth enclosed.
JUVENILE LEAVES.
E.rubida. --ovate-orbicular.
E.amygdalina-lanceolar.
MATURE LEAVES.
Intramarginal vein distant from edge.
Ovate.
Intramarginal vein moderately distant.
Lanceolar.
Veins oblique.
Asymmetric.
Veins longitudinal
Almost symmetric.

3. EXCURSION TO MARYSVILLE.

Saturday, 18th August, and Sunday, 19th August, 1923.

Flora of Mountain Gullies.

(*By R. T. Patton, B.Sc., M.F.*)

The route from Melbourne to Lilydale is through similar country to that seen at Eltham. The bed rock is composed of Silurian slates and sandstones, and the hills are low. In this section the annual rainfall is from 25 to 30 inches, and the vegetation is xerophytic. About Ringwood may be seen the Mealy Stringybark (*E. cinerea*). This tree never forms a good bole and is always stunted. Both the young shoots and the juvenile leaves have a mealy appearance. Beyond Lilydale the country is agricultural and more level. The Candle Bark Gum (*E. rubida*) stands out boldly on the hillsides. This tree appears to have the capacity of forming long clean boles even when grown singly. At Healesville the foothills are reached. Just beyond these there is a change from Silurian to igneous rocks. These rocks extend from here to Marysville, but they are not of the same type throughout. At the commencement we meet with Dacite, but further on Granodiorite will be found. Both of these rocks have the same chemical composition, but they yield widely differing soils. The Dacite is the lava form of the Granodiorite. A red clayey soil is yielded by the Dacite, while the Granodiorite breaks down to one which is coarsely granular. Both bear the same vegetation where climatic conditions are similar.

From Healesville to Marysville the rainfall rises from 35 to 50 inches. After just passing through Healesville, Long-leaved Box (*E. elaeophora*) may be seen. Most of the trees of the Silurian area are now left behind and others are found. Persistent-barked Eucalypts, Messmate, Stringybark, and Peppermint are found together with a dense scrub. Most of these scrub plants will be seen individually later on. On the left of the road is Mount Monda, and its sides are clothed with taller and straighter trees than on this the western slope. At the old site of Fernshaw is seen the first of the very tall Mountain Ash (*E. regnans*). These have persistent bark on the lower portion of the trunk, the upper part of the bole being smooth and clean. These trees have a characteristically narrow crown with very short branches. This character is not common to the Eucalypts. From here to the top of the Blacks' Spur Mountain Ash occurs to the left. As the valley gradually narrows the shrubs and tree ferns common to the typical associations of our gullies are seen. All of these will be seen on the walks from Marysville.

Passing over the Spur, a panorama of the headwaters of the tributaries of the Goulburn is seen. Away to the north is Cathedral Mount. There is here a somewhat abrupt change in the trees, for Peppermint (*E. amygdalina*) once again is seen. Here the aspect is northerly. A short distance to the right is seen Mount Dom Dom clothed on its southern slope with long boled trees and

on its northern with smaller trees. In a sheltered valley just near the Hermitage the Mountain Ash once again is found. The aspect here is easterly. Just opposite the Narbethong Hotel there is a clump of White Gums (*E. viminalis*). A little further along, on the right of the road just after passing the school, is a patch of Swamp Gums (*E. ovata*). These are the only specimens that will be seen on this excursion. The foliage is open and rather sparse. The trunk is short and of a dirty white colour. The leaves are broad, ovate and waved.

About 2 miles from here on the left of the road is St. Fillans, where there is a fine avenue of exotic trees. From here to Marysville the dominant trees are Peppermints, although Messmate (*E. obliqua*) is frequently seen. Just after passing the only house on the road, a patch of white gums occurs, and just beyond this again appears the Broad-leaf Peppermint (*E. dives*). We come to another stretch of this species just over the crest of the last hill before reaching Marysville. This tree will not be seen again on any of the excursions or walks. The leaves are broad, more or less oval, and bluish-grey in colour. It is not usually as large as it is here. It prefers the mountain country. Along this part of the route the scrub is not dense, and individuals may be readily distinguished. All of these will be seen at Marysville on the first walk.

The road from Marysville to Steavenson Falls first lies through a peppermint forest. The trees are above average size for this species. One of the most conspicuous of the shrubs is *Acacia linearis*, so called on account of its leaves. Associated with this is the Silver Wattle (*A. dealbata*), which has doubly pinnate leaves. Standing erect with thin wiry stems and opposite cordate leaves is *Platylobium formosum* (N.O. *Leguminosæ*). Another undershrub is *Goodenia ovata* (N.O. *Goodeniaceæ*), which has thin denticulated leaves. This plant occurs also along the coast. Another shrub is *Lomatia ilcifolia* (N.O. *Proteaceæ*), which has large stiff serrated leaves. This association gradually changes, and patches of *Goodia lotifolia*, with its soft delicate compound leaves, are seen. Ferns now become common. Very conspicuous is *Davallia dubia* on account of its pale yellowish-green colour. Two very similar ferns, usually found near each other, are *Lomaria discolor* and *Blechnum cartilagineum*. The former genus is characterized by the fact that the sterile and fruiting fronds are different, while in the latter they are the same. *Blechnum cartilagineum* has very long, broad, firm fronds with numerous pinnæ. Another common fern is *Aspidium aculeatum*, the fronds of which are dark green in colour and frequently have young ferns arising from buds near their apices. The rachis is covered with dark brown scales.

As the Peppermint is replaced by the Mountain Grey Gum (*E. goniocalyx*) there is a change in the shrub vegetation. *E. goniocalyx* has its trunk spotted with colour, usually shades of slaty-blue. This readily distinguishes it from the Mountain Ash, which has fibrous barked butt. The colour of the clean portions of the bole of the Ash is pale olive-green. From here to the falls the shrubs typical of the gully association now occur. Two small trees belonging to the N.O. *Compositæ* are conspicuous members of this association. One

is the Musk (*Aster argophyllus*). It has a musk-like odour and has large, elliptical, firm leaves, silvery beneath. The other is the Blanket-wood (*Senecio Bedfordi*), which has large, firm, lanceolate leaves which are quite woolly beneath. Both of these trees have what appear to be xerophytic characters, but they are never found away from the gullies. A very beautiful shrub is the tall *Correa Lawrenciana* (N.O. *Rutaceæ*), which is only found in the mountain regions. A tall shrub, conspicuous because of its dark, glossy, denticulated, opposite leaves is *Hedycarya Cunninghami* (N.O. *Monimieæ*). In places the leaves of this tree will be seen to be affected with the leaf blotch *Glœosporium Hedycaryæ*. There is only one other species belonging to this order, and that is the Native Sassafras (*Atherosperma moschatum*). There is a single tree of this, right at the foot of the falls, but it will be frequently met with on the second walk. Both of these trees are diœcious. Occasionally may be seen the small-leaved *Coprosma Billardieri* (N.O. *Rubiaceæ*), which has spinescent branches. Small leaves and spines are rare in this association, but they are quite typical of the plants at Cheltenham. Three climbing plants are very common. *Clematis aristata* (N.O. *Ranunculaceæ*) is easily recognised by its tendril-like petioles. Perhaps the most conspicuous is the Supple Jack (*Lyonsia straminea*—N.O. *Apocynaceæ*), which at times forms long ropes. It has opposite, long, simple, lanceolate leaves and climbs by twining. Another twiner is the Native Tecoma (*Tecoma australis*). It is easily recognised by its pinnate shining leaves. Somewhat rare is another climber *Billardiera longifolia* (N.O. *Pittosporaceæ*). This never assumes the size of the other climbers.

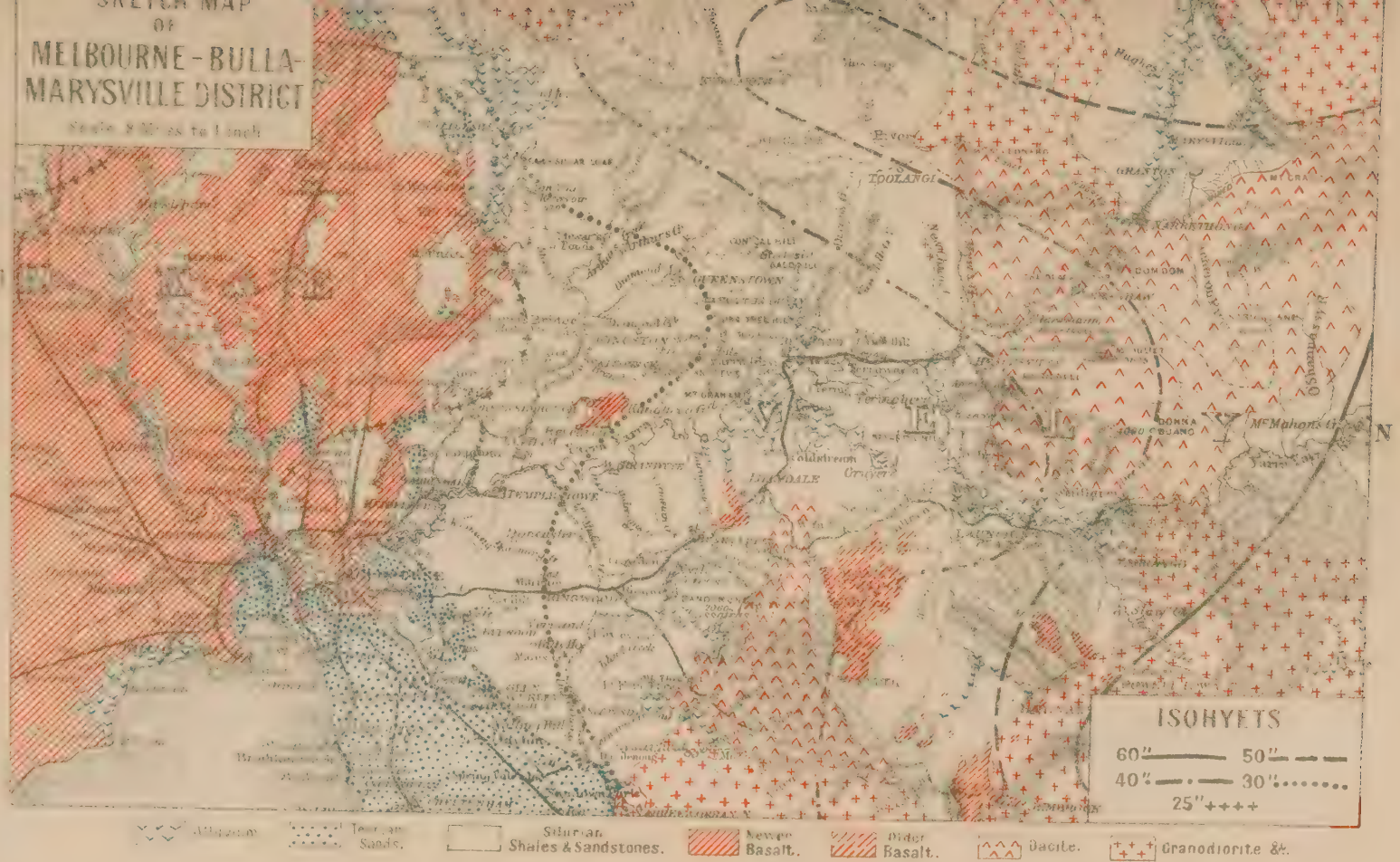
Two tree ferns are present, the tall slender one on the hillside is *Alsophila australis*, and the one most frequently found in the gully is *Dicksonia antarctica*. The genus *Dicksonia* has marginal globular sori with an indusium, while *Alsophila* has naked sori and the fronds are silvery beneath. At the side of the falls is a clump of coral fern (*Gleichenia circinata*). Just on the upper side of the track at the falls is a somewhat uncommon *Pteris* (*P. falcata*), which is very like a *Lomaria*. At the side of the falls also is Tea Tree (*Leptospermum attenuatum*). This genus is met with on other excursions. A tree which is conspicuous on account of its sharply serrated, glabrous leaves is *Lomatia Fraseri*. Scrambling over the shrubs, and making one's progress through the bush rather difficult, is the Wire Grass (*Tetrarrhena juncea*). A tall bluish-green shrub is prominent in places on account of its leaves and colour. This is *Tieghemopanax sambucifolius* (N.O. *Araliaceæ*), and it has pinnate leaves. A tall wattle with rather broad phyllodes occurs only occasionally. This is *Acacia penninervis*.

The road from Marysville to the Cascades runs at first through very similar country to that seen on the falls route. Soon, however, after the river is reached many new plants are seen. Near the three-mile point there is a patch of Umbrella Fern (*Gleichenia flabellata*). It is on the river side of the road, and difficult to find. Just a little further on is a solitary specimen of the King Fern (*Todea barbara*). This fern is peculiar in that it usually has several crowns.

Along the river the Beeches (*Nothofagus Cunninghami*) are plentiful. Associated with these are the Sassafras and Blackwood (*Acacia melanoxylon*). The Sassafras is easily recognised by its light almost yellow green foliage, and the Blackwood by its dense dark green foliage. Along the bank on the right-hand side of the road a small *Coprosma* (*C. hirtella*) occurs at intervals. It is a dwarf shrub, with large, ovate, shining, succulent leaves. Succulence is a character not often met with here. Associated with this is *Eriostemon myoporoides* (N.O. *Rutaceæ*), characterized by its long, elliptical, simple, coriaceous leaves. Another species of the same order is *Zieria Smithii*, which has fairly large ternate leaves.

Leaving the vehicles at the camping ground we follow the foot track leading up through some fine Beeches, one of which is a very fine specimen. On this walk may be noted a very large number of *Basidiomycetes*, particularly species of *Polyporaceæ* and *Agaricaceæ*. Three species of *Lomaria* are found here. The commonest, *L. capensis*, grows plentifully along the track. This species has a coarse appearance and the rachis bears numerous brown scales. All the species of *Lomaria* found here are simply pinnate. The very long-leaved *L. fluviatilis* has extensively pinnate, narrow fronds. The pinnæ are almost oval and somewhat membranous. Rather rare is the dark green *L. lanceolata*, which is found mostly in well-sheltered spots. The fronds are very lanceolate and the pinnæ extend right to the base of the rachis, but the lowest pinnæ are very short. The genus *Polypodium* is represented by three species. One is dwarf, and is found only on the trunks of the tree ferns. This is *P. australe*. The fronds are narrow, lanceolar, entire, and are only about four inches in length. Another species, *P. pustulatum*, also occurs on the tree ferns, but is found on the trees in addition. The fronds may be either entire or irregularly lobed, shining, conspicuously veined, and usually about nine inches or more in length. The sori are circular and very large. Very different from these two is the terrestrial species (*P. punctatum*), which has very large, repeatedly pinnate fronds. The sori are very small and light brown in colour. Occasionally may be seen the very delicate *Pteris incisa*, which is usually only found in secluded places. *Asplenium bulbiferum* is fairly common towards the Cascades. The species name is due to the fact that the fronds are frequently covered with young plants.

The trunks of the tree ferns are the home of myriads of tender ferns and mosses. The filmy fern, *Trichomanes venosum*, in places covers the whole of a single stem. It may be noted that they are always thickest on the most sheltered side. Associated with this is the *Selaginella*-like Moss (*Cyathophorum pinnatum*). Along the side of the track towards the Cascades are several patches of the giant Moss (*Dawsonia juniperina*). Grasses are rare, but on the side of the small track leading down into the Cascades are several clumps of the Mountain Oat (*Glyceria dives*), which is characterized by its very broad leaf.


SKETCH MAP
OF
MELBOURNE - BULLA - MARYSVILLE DISTRICT
Scale 3 Miles to 1 Inch
BOU
N
TOOLANGI
QUEENSTOWN
DONNA BUANG
McMahons Cr
ISOHYETS
60"
50"
40"
30"
25"
Alluvium
Tertiary Sands.
Silurian Shales & Sandstones.
Newer Basalt.
Older Basalt.
Dacite.
Granodiorite &c.

4. EXCURSION TO CHELTENHAM.

Tuesday, 21st August, 1922.

Scrub Association on Tertiary Sands at Cheltenham.

By R. T. Patton, B.Sc., M.F.

Immediately behind the railway station is Cheltenham Park, which is really a large sand dune. The flora of this is partly made up from that of the sea front, partly from the tertiary plains immediately behind. These dunes carry a fair growth of trees while the plains are almost treeless. The reason probably is that owing to the greater depth of sand there is a greater abundance of moisture at lower levels than on the plains. The dominant tree is the coast tea-tree, *Leptospermum laevigatum* (N.O. *Myrtaceæ*). This tree has followed the drifting sands to wherever it has formed dunes, and some very fine old specimens are to be seen here. The acacia of the coast is not to be found here, but another acacia may occasionally be seen, namely, *A. armata*, so named on account of its spiny stipules. The coast honeysuckle, *Banksia integrifolia* (N.O. *Proteaceæ*), is here replaced by a smaller species, *B. marginata*. This latter is distinguished from the former by its broad-linear leaves. The coastal species has leaves which are acute at the summit. The honeysuckle timber is remarkable for the large portion of the stem taken up with medullary rays. The sheoak (*Casuarina stricta*, N.O. *Casuarineæ*) found occasionally along the coast, but abundantly elsewhere, is replaced here also by a smaller species, *C. suberosa*. This is a rather rare tree, and single trees are found only at long intervals. This tree is found also in the foothills of the mountains. This species is readily distinguished from *C. stricta* by its dark green colour and slender branchlets. *C. suberosa* has six to eight scale leaves, while *C. stricta* has nine to twelve. We have here also a Eucalypt known commonly as white gum, because its buds, leaves, and fruits are exactly similar to those of the white gum of our river valleys. The habit of the two trees is quite dissimilar. This variety never forms a good straight bole and its bark is persistent, not shed as is the case with the true gums. Some good specimens are to be seen here. Along the road at the side of the park are some fine trees of the two pines, *Pinus insignis* and *P. canariensis*. Both these trees have done well wherever planted in this sandy country.

Leaving this sand dune we come to the tertiary plain which stretches from Melbourne to the ocean along the eastern shores of Port Phillip Bay. This country is largely covered by scrub and only at intervals do trees occur. This plain consists of sand overlying clay with frequently an ironstone rubble a couple of inches in thickness lying between. The depth of the sand varies widely, but from 2 to 3 feet may be considered an average depth. The underlying clay prevents the percolation of rain to lower levels. This tract of country was formerly the market garden area of Melbourne, but now both market gardens and the last remnants of scrub are disappearing before the rapid southward extension of the city. It is the ease with which this soil

can be cultivated, combined with its fertility, which has made this district so popular as a residential area. The soil needs plenty of water and it rapidly dries out in summer. Its water-holding capacity is only about 25 per cent., but in nature it never has anything like this. A series of moisture tests taken continuously during a year showed that as a rule the highest content recorded in the upper 7 inches was a little over 10 per cent. Typical results taken in June and July, 1922, are given below. The percentage of moisture was taken for each of the inches separately.

	Moisture Content.	
Depth.	June.	July.
1″	11·9	18·6
2″	9·8	10·0
3″	10·4	8·8
4″	7·4	9·9
5″	7·1	9·0
6″	6·9	9·0
7″	6·4	9·1

The first four months of the present year were exceedingly dry, and the soil was about as dry as it ever gets. The moisture content during the dry period was a little over 1 per cent. A series of results taken in April are as follows :—

Depth.	Per cent. of Moisture.
3″	0·97
9″	1·25
15″	1·07
21″	1·27

The soil was in a very favorable condition for the observation of penetration of rain water. Field records went to show that one inch of rain penetrates the soil to a depth of about 8 inches. The penetration of the water was tested in the laboratory, and the following results are in accord with the field observations. Two inches of water were poured on to a column of sand and allowed to percolate through the soil. After three weeks the percentages of moisture were calculated.

Depth.	Percentage of Moisture.
1″	9·6
3″	8·95
5″	8·95
7″	8·10
9″	7·10
11″	6.86
13″	5·60
15″	1·11
17″	1·12

The rainfall of Melbourne is very regular as regards monthly amounts as the following shows :—

Rainfall.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Inches ..	1·85	1·74	2·18	2·32	2·15	2·11	1·86	1·81	2·35	2·64	2·20	2·30	25·51

It is not correct to say we have a winter rain, for the differences in monthly rainfall are not great. The range is only from 1·74 to 2·64. The rainfall during the six summer months is 12·91 while in the winter it is 12·60 inches. So far as plant life is concerned the rainfall of the first three months of the year is valueless. This is practically all lost by evaporation. Field tests show that it is not till April as a rule that the soil moisture is sufficient for plant needs. When the soil is so dry it is remarkable how some plants manage to keep flowering. A composite *Hypochaeris radicata* may be found in flower at almost any week of the year. The same is largely true of the native fuchsia (*Correa speciosa* N.O. *Rutaceæ*). The flowering period does not commence until about August, but it is not until October that the maximum flowering is reached. After this, flowering rapidly declines. The evaporation curve crosses the rainfall curve in October. For the first three months evaporation largely exceeds rainfall. In April rainfall and evaporation are the same. It may be remarked that the evaporation records are taken from a water-free surface. Although field conditions differ widely from this, it is surprising how closely moisture content in the field for the hot months agrees with the water surface records. The rainfall during the effective months—April to October—is 15·24, while the evaporation is 14·95 inches. The high figure for evaporation is not reflected in the moisture content of the soil. During these months the moisture content remains very similar and evaporation is very small. During the summer months the relative humidity has been as low as 11 per cent. The hot weather combined with low humidities sets in on November, and this combination is the controlling factor in the vegetation.

This association is markedly xerophytic and is a typical scrub. There is a very close relationship between the plants of this association and that of the beach, for many genera are represented in both. The beach association is undoubtedly derived from this one. Although so close to one another and so similar as regards soil, no prominent species is common to both. There is another interesting fact, and that is that the coastal belt is poor in species while the scrub is exceedingly rich. Trees are rare, and practically the only one is *E. vimmalis* already mentioned. The two chief species of the association belong to the genus *Leptospermum*, namely, *L. scoparium* and *L. myrsinoides*. Both of these have very small leaves and thin wiry stems. *L. scoparium* has spiny leaves, a character which is present in many plants here, but is not seen in the beach flora. The reduction of the leaf area and the thin stems are the two chief characteristics of this scrub. The height is also characteristic, being generally about 3 feet. The genus acacia is represented by a particularly spiny species, *A. oxycedrus*. Like the beach species there are no leaves

but phyllodes. In both, the inflorescence is a spike. The N.O. *Proteaceæ* has two genera present. One is a small variety of *Banksia marginata* and the other is truly protean in its form. This is *Isopogon ceratophyllus*, whose leaves are reduced practically to spines. The Banksias have relatively large leaves for typical xerophytes, but the leaves are protected above by a thick cuticle and below by appressed cottony hairs. The species of *Casuarina* is nothing better than a scrub. Its fruits are small like those of *C. suberosa*, the largest fruit being found on *C. stricta*. This species is *C. distyla*. Its branchlets are very short, as are also the internodes. They have six to eight rudimentary leaves. The N.O. *Epacrideæ* which is represented at places along the coast by a large shrub or small tree (*Leucopogon*) is abundantly represented here. *Epacris impressa*, as well as the species of *Leucopogon*, are very similar in character to *Leptospermum scoparium*. The leaves of all these terminate in spines and are all reduced in size. This order corresponds as regards habitats to *Ericaceæ* in the Northern Hemisphere. The anthers are adnate to the tube of the corolla. *Leucopogon* has several species, but all of these are below the general level of the scrub. There is one prostrate species of this order known locally as cranberry. It is *Astroloma humifusa*. The flowers are tubular and red. Being prostrate it is often very difficult to find. The native fuchsia, *Correa speciosa* (N.O. *Rutaceæ*), may be found in flower almost throughout the year. It differs from other members of the order by having a tubular corolla. Along the beach, in close proximity to here, may be found another *Correa*, *C. alba* having, as the name implies, white flowers. One peculiar feature of this flora is the abundance of species of the sub-order *Papilionaceæ*, which are absent from the beach. The most beautiful perhaps is a prostrate species known as the Running Postman (*Kennedya prostrata*), on account of its scarlet flowers. It has no special xerophytic character and is to all appearances a mesophyte, yet it grows freely. Another prostrate species is strongly xerophytic. This is *Platylobium obtusangulum*. Typically spiny is *Daviesia ulicina*. The genus Hibbertia has three species present. The smallest *H. fasiculata* is semi-prostrate and has fine linear leaves. A conspicuous shrub when in flower is the dicœcious Wedding Bush, *Ricinocarpus pinifolius* (N.O. *Euphorbiaceæ*). Male plants always appear to be much more common than female.

Climbing plants are rare in this scrub. The native dodder is common, *Cassytha glabella* (N.O. *Lauraceæ*). This plant is parasitic, and in some parts of the State is attacking exotic plants. One of the sundews is also a climber, *Drosera Menziesii*.

Ferns are even more rare than climbers. The common bracken, *Pteris aquilina*, is common. When this land is cleared and allowed to lie idle bracken rapidly takes possession, practically to the exclusion of all other associated forms. A very humble but very beautiful little fern is *Lindsaya linearis*, which grows under the shelter of the larger shrubs.

Literature.—*The Sandringham Flora*. Dr. C. S. Sutton, Victorian Naturalist. Vols. xxviii. and xxix.

Epacris impressa.

Astroloma humifusum.

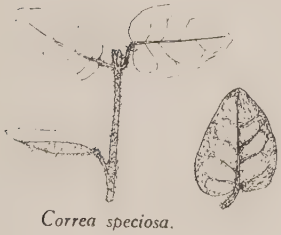
Leucopogon virgatus.

Monotoca scoparia.

Acacia oxycedrus.

Bossiaea cinerea.

Platylobium obtusangulum.



Correa speciosa.

Ricinocarpus pinifolius.

Hibbertia densiflora.

Hibbertia fasciculata.

Daviesia ulicina.

Banksia marginata.
SHRUB.

B. marginata.
TREE.

Isopogon ceratophyllus.

Casuarina distyla.

SECTION 5.—FORESTRY.

FORESTS OF VICTORIA.

The total area of the State is 56,245,000 acres, of which about 12,000,000 acres are woodland. The area of permanent forests is 4,149,019 acres. This represents the amount set apart under the Forests Acts as being inalienable for any other purpose whatever, with a few minor exceptions. The responsible Forest Authorities of the Commonwealth, meeting in Conference in 1919, resolved that the minimum requirements for Victoria for the purpose of providing timber and forest products should amount to 5,500,000 acres. It will thus be seen that the quota of forests for this State is nearly 1,500,000 acres short of the margin of safety for future timber supplies.

From time to time, no doubt, further timbered areas will be added to the Forest Reserves, as the various State Administrations have agreed to quotas set down at the Forest Conference mentioned above. Of the State Forest domain some 2,500,000 acres are situated on the slopes of high mountain ranges, and their protection is essential to the maintenance of streams and springs. Another 500,000 acres of Forest are situated in the Eastern portion of the State, where transport facilities are lacking to a great degree. A further 500,000 acres, chiefly situated in the Central Districts, have been cut over and are closed for the protection of the young timber. It will thus be seen that the available supplies of timber for the various industries are drawn from a comparatively small acreage, and as this is depleted the cost of exploitation of the Forests further afield will necessarily increase.

In this extent of Forest Land the distribution of the eucalypts will be found to occur in the following manner. In the higher elevations over 1,500 feet and ascending to 3,500 feet south of the Dividing Range, Forests of Mountain Ash (*Eucalyptus regnans*), Messmate (*E. obliqua*), Silvertop (*E. Sieberiana*), Woolly-butt (*E. Delegetensis*), Blue Gum (*E. globulus*), and Mountain Gum (*E. goniocalyx*), with Blackwood (*Acacia melanoxylon*) in the moist gullies and valleys. On the Lower foothills and plains in the southern portions of the State, Messmate will still be found and also Manna Gum (*E. viminalis*), and along the courses of the rivers and streams Redgum (*E. rostrata*). In the Eastern parts of the State the Red Ironbark (*E. sideroxylon*), Grey Box (*E. Bosistoana*), Yellow Stringybark (*E. Muelleriana*), White Stringybark (*E. eugenioides*), Brown Stringybark (*E. capitellata*), Red Stringybark (*E. macrorryncha*), Gippsland Mahogany (*E. botryoides*), Bloodwood (*E. corymbosa*) grow, although some of these species may be found in other parts also. Over the Dividing Range in the drier parts of the State the prevailing species are Red Ironbark (*E. sideroxylon*), Grey Box (*E. hemiphloia*), Yellow Gum (*E. leucoxylon*), and Yellow Box (*E. melliodora*), whilst along the courses of the tributaries to the River Murray and on each side of this river the Redgum (*E. rostrata*) flourishes. The predominant tree of the State is the Mountain Ash (*E. regnans*). Acacias also grow in various parts, and the chief tanning varieties

are Black Feather-leaf Wattle (*Acacia decurrens*) and Golden Wattle (*A. pycnantha*). Blackwood (*A. melanoxylon*) is greatly sought after for higher cabinet work, much of the wood being beautifully figured.

The absence of softwoods in Victoria has made it imperative that plantations of these timbers be formed if the State is to be in any degree self-supporting as far as timber supplies are concerned. Accordingly, exotic conifers have been experimented with and, fortunately, most of the better class have proved eminently suitable, their growth showing that the climate and soil of the State suit them very well. Over 7,000 acres of softwood plantations have been successfully planted. The first place must be given to the *Pinus insignis* (Monterey Pine), as it has been found to flourish in all the cooler parts of the State, growing even where the indigenous growth has shown small prospect of ever attaining useful proportions. Second on the list is the Corsican Pine (*Pinus laricio*), which shows vigour of growth and is healthy and hardy wherever planted. In the higher elevations the Douglas Fir (*Pseudotsuga Douglasii*), Redwood (*Sequoia sempervirens*), Menzies Spruce (*Abies Menziesii*) now classed as *Picea Sitchensis*, and the Bull or Western Yellow Pine (*Pinus ponderosa*) have all proved their suitability, and in future years a very profitable asset to the Commission will accrue when the crops of these species are ready for exploitation.

Macedon Nursery.

Macedon State Nursery is situated 46 miles from Melbourne, and its elevation above the sea-level is 1,660 feet. It comprises an area of about 90 acres, and was established 46 years ago. This Nursery is noted for its splendid collection of exotic trees, chiefly of the Coniferous family, amongst these being some very fine specimens. One hundred and thirty thousand trees are distributed annually to State Schools, Public Institutions, and the general public.

General Description of Nursery.

This Nursery is favorably situated in a deep gully, being sheltered by the Dividing Range. A large reservoir has been formed in the Nursery grounds, and is the source of the supply of water for Nursery operations during the summer months. The soil is a schistose clay, in which the Conifers thrive. In the early days of this Nursery, a large variety of specimens was planted with the object of ascertaining which would be of the most use to the Department when creating permanent plantations of soft-wooded trees, and after many years of experimental work, it has been conclusively proved that in the Macedon climate the following trees have proved most suitable :

Pinus ponderosa.
Pinus insignis.
Pinus laricio.
Pseudotsuga Douglasii.
Cedrus Deodara.
Picea Sitchensis.

Specimens of note.

The *Pinus ponderosa* and *Pseudotsuga Douglasii* show remarkable vigour, and produce an abundance of fertile seed, which is carried by the wind to all parts of the Nursery, and there germinate and grow in thousands, during each season.

Some of the specimens have attained considerable size in comparatively a short time—notably a tree of *Pinus ponderosa*. This tree is 40 years old, about 100 feet high, and has (at breast height) a circumference of 11 feet. In addition to this tree fine specimens of the Douglas Fir, Indian Cedar, and *Sequoia sempervirens* and *gigantea* also flourish. Amongst the broad leaf section, good specimens of *Quercus palustris*, *Quercus Lusitanica*, *Tilia Europea*, *Fagus sylvatica* var. *purpurea*, *Populus alba*, *Acer pictum*, *Quercus castanea*, *Fraxinus excelsior* var. *pendula*, &c., are to be met with. In the plantations attached to the Nursery, some fine stands of *Pinus insignis* (second crop), *Pinus laricio*, and *Pseudotsuga Douglasii* may be seen, these trees showing remarkable growth in a country having a climate so different from that of their natural habitat.

Mount Macedon Plantation.

Situation :—North Central Victoria. Spur of Main Dividing Range, rising to a height of 3,330 feet.

Mt. Macedon is one of a chain of extinct volcanoes, the soil being dark volcanic. This range forms an important watershed for stream-flow northward to the Murray River, feeding irrigation lands on its way, and southward to Port Phillip Bay. Clothed at one time with valuable native forest growth—Silver Top (*Eucalyptus Sieberiana*), Mountain Ash (*E. regnans*), Messmate (*E. obliqua*), Blackwood (*Acacia melanoxylon*), and a dense undergrowth of Musk, Hazel, Native Mulberry, and Lilac (*Prostanthera*)—five sawmills operated in the area of 5,000 acres with the result that the original forest was cut out without regard to future regeneration, and the land taken possession of by the bracken Fern (*Pteris aquilina*). About 40 years ago an attempt was made to re-forest the area with *Pinus insignis* with a view to preventing soil erosion, and for the conservation of water. Its value as a timber tree was not then known, and was established only in recent years. During the Great War, when the importation of soft-woods into Australia had practically ceased, *Pinus insignis* was in great demand for commercial purposes, and is still largely used in the manufacture of three-ply, butter boxes, fruit cases, &c. The trees grown at Mt. Macedon have yielded as high as 3,000 superficial feet per tree, and have realized at the stump prices varying from 9s. to 14s. per 100 superficial feet. As a quick timber producer it takes first place, being ready for final cropping between the twenty-sixth and thirtieth years, its average rate of growth being three feet per annum, although a yearly increase of up to six feet is not uncommon. The first thinnings are usually made between the twelfth and fifteenth years, and the logs obtained have a ready sale for conversion into box material.

Whilst experience has shown that *Pinus insignis* is the fastest-growing conifer planted in this State, *Pinus laricio*, a native of the south of France and the island of Corsica, in the Mediterranean Sea, is showing great promise and thrives well at Mount Macedon, having a yearly growth of from 2 to 3 feet. Extensive plantations are being formed of this tree, which yields a timber of

equal durability and usefulness to that of Scot's Pine (*Pinus sylvestris*). The Douglas Fir (*Pseudotsuga Douglasii*), the first plantings of which were made at Mount Macedon in 1916, grows equally as well as *P. laricio*. The species shows wonderful vitality, and, though at times young plants may be hindered in early growth by wallaby or rabbits, they soon recover and, sheltered by the covering of bracken fern, quickly grow out of reach of destroying influences. Like the *Pinus insignis*, the seed of this tree is fertile, and under the older specimens many seedlings may be seen. *Picea Sitchensis* has not been extensively planted, but specimens 40 years old at Mount Macedon are very noble trees. In the past only small plots were planted, but further planting is in progress this season.

Pinus ponderosa.—Unfortunately, rabbits are particularly fond of this species and greatly hamper its growth. When this difficulty is overcome, however, it makes good progress, and like *Pinus Jeffreyii*, which it resembles, has an average growth of 18 to 24 inches yearly.

Small plantings have been made of *Sequoia sempervirens* (Redwood), and it is doing well in the sheltered gullies at Upper Macedon, the annual growth ranging from 2 to 3 feet.

Creswick Nursery.

Creswick Nursery is situated adjacent to a town of that name, and stands at an elevation of approximately 1,400 feet above sea-level, and is 86 miles from Melbourne. The important city of Ballarat is adjacent, 11 miles nearer the metropolis. The climate, soil, and elevation renders the locality peculiarly suitable to the growth of exotic trees. For many years prior to 1906 a supply nursery had been established to raise pines of various sorts for planting areas in the immediate neighbourhood. About the year 1907, when it was decided to further plant extensively conifers in various parts of the State, Creswick Nursery was established in the bed of the gully, locally known as Sawpit, from the fact that in past times a saw-mill had been working there cutting the indigenous timber in the locality. Since that time many millions of tree plants have been propagated. As will be seen, areas surrounding the nursery have been extensively planted with Conifers of several species, the principal varieties being *Pinus insignis* and *Pinus laricio*. An inspection of the growth of these exotic pines will disclose the suitability of the locality for their growth. It is yet too early to exhibit specimens of tree growth like that at Macedon Nursery, but a comparative table at the end of this pamphlet, showing the growth of various Conifers at Macedon and Creswick, and specimens growing in England, Scotland, and Ireland, is interesting, and will give some idea of the suitability of the soil and climate of Victoria for them.

Forest School, Creswick.

Another point of interest to a visitor is the Forest School, established in 1911, for the training of the future foresters of the Commission. Here boys are admitted at ages ranging from fourteen to seventeen years, and after three

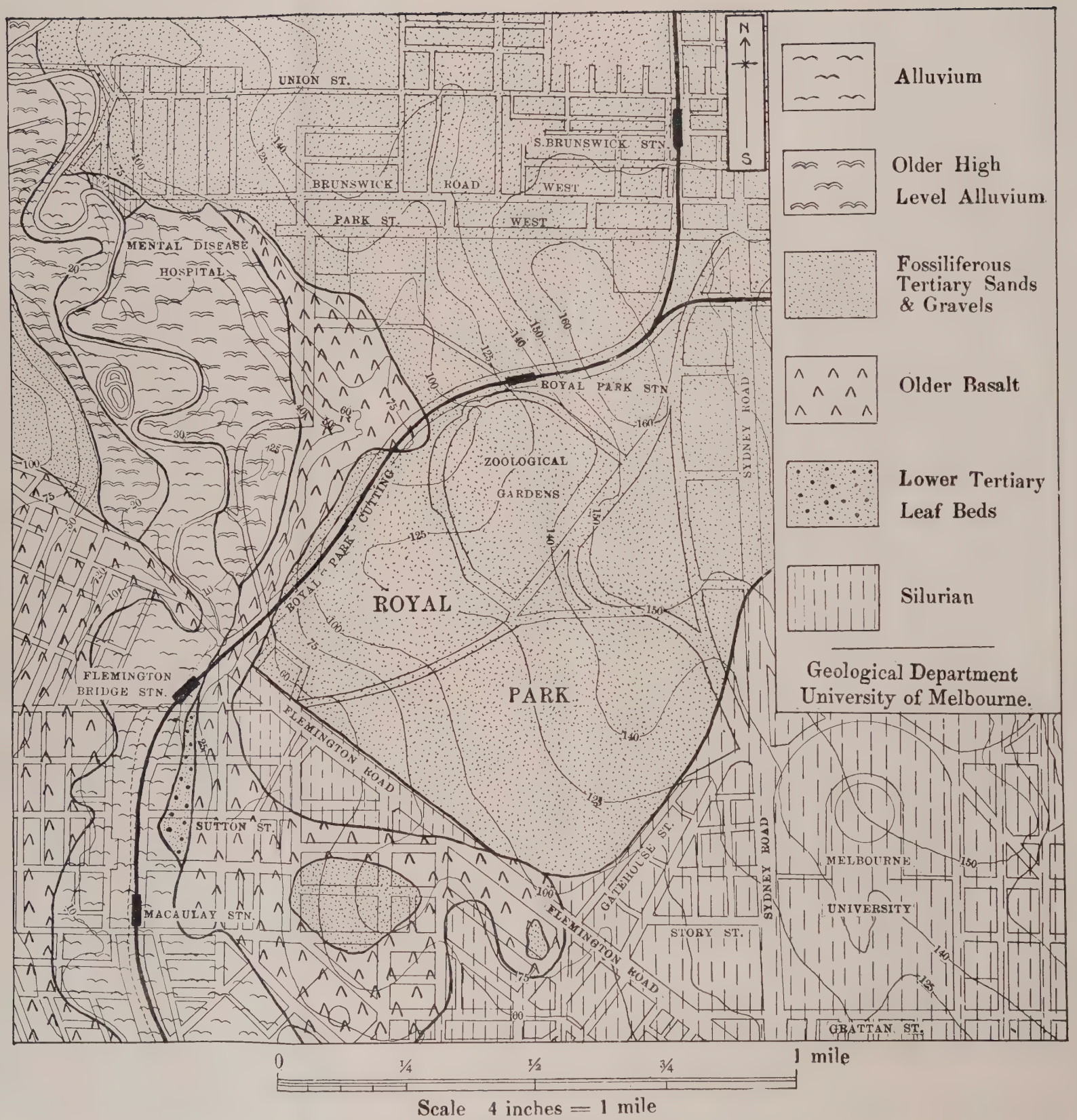
years' training at the school, and passing the final examination of Cadet Forester, are sent into the open forest for a further term of practical forest work, after which they are detailed for duty under an experienced forester in whatever part of the State their services may be required. The course at the school includes botany, chemistry, geology, mathematics, surveying, physics, and instruction as to those plants and animals injurious to forest trees, nursery and plantation work, and elementary forestry.

Growth of Conifers in Great Britain and Victoria.

Common Name.	Botanical Name.	Place.	Height.	Girth.	Age (Years).	Soil.
			ft. in.	ft. in.		
Corsican Pine	*Pinus laricio*	Boconnoc, E. ..	79 0	5 9	40	Loam ; s.s. loamy spar
		Hopetoun, S. ..	71 0	7 3	70	Sandy loam ; s.s. till*
		Fota, I. ..	70 0	..	..	Light loam ; s.s. marl
		Macedon, V. ..	43 0	4 9	14	Poor schistose clay
		Creswick, V. ..	53 0	3 2	17	,, ,,
Monterey Pine	*P. radiata, vel insignis*	Linton Park, E.	62 0	10 0	45	Stiff loam ; s.s. Kentish rag
		Dropmore, E...	90 0	11 0	52	Light loam; s.s. gravel
		.. ..	79 0	12 0	52	
		Powerscourt, I.	82 0	10 0	32	Loam, peat ; s.s. gravel, sand
		Macedon, V. ..	108 0	10 6	26	Poor schistose clay
		Creswick, V. ..	110 0	12 0	34	Alluvial clay
		,, ..	115 0	10 7	34	..
		,, ..	80 0	5 0	18	,,
		,, ..	53 0	3 0	17	Poor schistose clay
Bull Pine	*P. ponderosa*	Linton Park E.	63 0	9 2	..	Stiff loam ; s.s. Kentish rag
		Orton-Longueville, E.	63 0	..	..	Fertile loam
		Whittinghame, S.	50 0	4 6	45	Red loam ; s.s. sandy gravel
		Macedon, V. ..	100 0	11 0	40	Poor schistose clay
Douglas Fir	*Pseudotsuga Douglasii*	Dropmore, E...	120 0	11 0	61	Loam ; s.s. gravel
		Lyndoch, S. ..	91 9	12 0	57	Loam ; s.s. till*
		,, ..	72 2	11 2	57	
		Dunkeld, S. ..	94 0	12 0	57	Light loam ; s.s. gravel
		Macedon, V. ..	81 8	6 2	34	Poor schistose clay
Menzies' Spruce	*Picea Sitchensis* (*Abies Menziesii*)	,, ..	72 0	6 10	34	,, ,,
Californian Redwood	*Sequoia sempervirens*	Boconnoc, E. ..	75 0	13 0	40	Loam ; s.s. loamy spar
		Fota, I. ..	75 0	7 6	..	Light loam ; s.s. marl
		Macedon, V. ..	66 0	6 9	34	Stiff clay ; s.s. schist
Himalayan Cedar	*Cedrus Deodara*	Studley Royal, E.	70 0	7 6	60	Loam ; s.s. limestone
		Rossie Priory, S.	70 0	5 9	..	Loam ; s.s. gravel
		Fota, I. ..	65 0	6 0	..	Light loam ; s.s. marl
		Macedon, V. ..	63 6	6 11½	34	Stiff clay ; s.s. schist

Contractions : E., England ; S., Scotland ; I., Ireland ; V., Victoria ; s.s., subsoil. * Till, boulder clay.

CAINOZOIC
Soil, Clays, Sandstones, Brown Coal and Limestone.
JURASSIC.
Felspathic Sandstones and Mudstones with Black Coal.
PERMO-CARBONIFEROUS AND CARBONIFEROUS.
Sandstones and Glacial Deposits.
DEVONIAN.
Sandstones, Limestones, Shales and Volcanic Rocks.
SILURIAN.
Sandstones, Mudstones, Slates, and Limestones.
ORDOVICIAN.
Slates and Sandstones.
HEATHCOTIAN.
Cherts, Diabase, and Tuffs.
METAMORPHIC.
In part Pre-Ordovician.
CAINOZOIC BASALT.
DACITE AND PORPHYRIES.
GRANITIC ROCKS.
GEOLOGICAL MAP OF VICTORIA
SCALE OF MILES
0 25 50 75 100
Mildura
Merbein
Hattah
Cowangie
Ouyen
Murrayville
Chillingollah
Swan Hill
Sea Lake
Hopetown
Woomelang
Kerang
Tocumwal
Yarrawonga
Rutherglen
Warracknabeal
Wedderburn
Rochester
ECHUCA
SERVICETON
DIMBOOLA
SHEPPARTON
WANGARATTA
WODONGA
Chiltern
Corryong
Tallangatta
BEECHWORTH
Craven
Mitta Mitta
St Arnaud
BENDIGO
BENALLA
BRIGHT
Harrietville
HORSHAM
Toolondo
MARYBOROUGH
Maldon
Dyoce
CASTLEMAINE
KYNETON
KILMORE
Whittlesea
Alexandra
MANSFIELD
Omeo
Cassilis
Gelantipy
Grant
Dargo
Jamieson
Marysville
Gaynays
Woods Pt
Healesville
Beaufort
Creswick
DAYLESFORD
Casterton
Glenelg
HAMILTON
Branxholme
Mortlake
PORTLAND
WARRNAMBOOL
Cape Nelson
Port Fairy
Cape Otway
Timboon
COLAC
Forrest
Crowes
GEELONG
PORT PHILLIP BAY
MELBOURNE
Warburton
Gembrook
Walhalla
Stratford
Moe
WARRAGUL
Morwell
KORUMBURRA
SALE
Port Albert
Wilsons Promy.
Queenscliff
Outtrim
Wonthaggi
Club Terrace
Genoa
Cape Howe
Orbost
Snowy R.
Tambo R.
Murray R.
Loddon R.
Avoca R.
Campaspe R.
Goulburn R.
Yarra R.
Latrobe R.
Hopkins R.
Glenelg R.
Wimmera R.
Barwon R.
Moorabool R.
Werribee R.
Bellarine Pen.
Mornington Pen.
Western Port
Phillip Island
Port Albert
Gippsland Lakes
Lake Tyers
Lake Wellington
Lake Victoria
Lake Hindmarsh
Lake Tyrrell
Lake Buloke
Lake Boga
Lake Charm
Lake Corangamite
Lake Colac
Lake Bullen Merri
Lake Purrumbete
Lake Gnotuk
Lake Keilambete
Lake Wallace
Lake Learmonth
Lake Burrumbeet
Lake Wendouree
Lake Goldsmith
Lake Bolac
Lake Modewarre
Lake Connewarre
Lake Murdeduke
Lake Gerang Gerang
Lake Buninjon
Lake Yambuk
Lake Condah
Lake Bullenmerri
Lake Gnotuk
Lake Keilambete
Lake Purrumbete
Lake Elingamite
Lake Terang
Lake Gillear
Lake Bullen Merri
Lake Colac
Lake Corangamite


N
S
Alluvium
Older High Level Alluvium
Fossiliferous Tertiary Sands & Gravels
Older Basalt
Lower Tertiary Leaf Beds
Silurian
Geological Department University of Melbourne.
UNION ST.
S.BRUNSWICK STN.
BRUNSWICK ROAD WEST
PARK ST. WEST
MENTAL DISEASE HOSPITAL
ROYAL PARK STN
ZOOLOGICAL GARDENS
SYDNEY ROAD
ROYAL PARK CUTTING
ROYAL PARK
FLEMINGTON BRIDGE STN.
FLEMINGTON ROAD
SUTTON ST.
MACAULAY STN.
GATEHOUSE ST.
STORY ST.
MELBOURNE UNIVERSITY
GRATTAN ST.
0 ¼ ½ ¾ 1 mile
Scale 4 inches = 1 mile

SECTION 8.—GEOLOGY.

1. THE GEOLOGY OF ROYAL PARK.

By F. A. Singleton, M.Sc.

(*Tuesday, 14th August*, 1923.)

Introduction.

Royal Park lies about 2 miles N.N.W. of Melbourne, and consists of a plateau of Tertiary sands and gravels, reaching a maximum height of 160 feet above sea-level. The western portion of the area is drained by the Moonee Ponds Creek, in the valley of which are exposed Older Basalt, Lower Tertiary leaf beds, and the Silurian bed rock, which latter also occupies the lower ground to the east and south-east of Royal Park.

The area was first mapped by A. R. C. Selwyn, with C. d'O. Aplin as assistant, and was included in Geological Quarter-sheet No. 1 N.W., on a scale of 2 inches to the mile, published in 1860.

In 1897 T. S. Hall and G. B. Pritchard[1] described the geology of the Royal Park Railway cutting, and gave a list of fossils from the Tertiary sediments.

Brief reference to the Royal Park cutting has also been made by F. E. Grant.[2]

A more complete account of previous literature may be found in the paper by Hall and Pritchard above referred to.

Silurian.

The bedrock of the district consists of sandstones and mudstones belonging to the lower or Melbournian stage of the Silurian system. It is fairly closely folded along axes with a more or less meridional trend and frequently exhibiting a southerly pitch. Petrological[3] and palæontological[4] evidence alike point to deposition in a relatively shallow sea, and the occasional occurrence of ripple-marked sandstones affords further confirmation of this.

Silurian strata outcrop over the south-eastern portion of the area, as shown on the accompanying geological map, and a small exposure occurs on the floor of the Royal Park cutting. In addition to these outcrops, a fine cliff section has been exposed by the Moonee Ponds Creek, immediately to the north of the Brunswick-road bridge. This section has been well known as a collecting ground for more than 60 years, and the following list of fossils has been recorded by Mr. F. Chapman[5] :—

Plantæ.

Palæachlya cf. *tortuosa* Eth. fil.

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[1] Proc. Roy. Soc. Vict., vol. ix. (n.s.), 1897, pp. 206–209, pl. viii.
[2] Rept. Aust. Assoc. Adv. Sci., vol. viii., 1901, p. 226.
[3] W. G. Langford, Proc. Roy. Soc. Vict., vol. xxix. (n.s.), pt. i., 1916, p. 47.
[4] F. Chapman, Rept. Aust. Assoc. Adv. Sci., vol. xiv., 1914, p. 213.
[5] *Op. cit.*, pp. 214–220.

Anthozoa.

Streptelasma cf. *aequisulcatum* McCoy sp.

Crinoidea.

Botryocrinus longibrachiatus Chapm.

Ophiuroidea.

Protaster brisingoides Gregory.

Sturtzura leptosomoides Chapm.

Asteroidea.

Palæaster meridionalis Eth. fil.

Palæaster smythi McCoy sp.

Palæocoma sp.

Urasterella sp.

Chætopoda.

Trachyderma crassituba Chapm.

Brachiopoda.

Camarotoechia decemplicata Sow. sp.

Lingula lewisii Sow., var. *flemingtonensis* Chapm.

Rhynchotrema liopleura McCoy sp.

Pelecypoda.

Cardiola cornucopiæ Goldfuss sp.

Palæoneilo victoriæ Chapm.

Cephalopoda.

Cycloceras ibex Sow. sp.

Kionoceras sp.

Trilobita.

Ampyx parvulus Forbes, vàr. *jikaensis* Chapm.

Calymene blumenbachii Brongn.

Homalonotus harrisoni McCoy.

Phacops latigenalis Eth. fil. et Mitch.

Phyllocarida.

Aptychopsis victoriæ Chapm.

Lower Devonian (?) Dyke Rock.

Traversing the Silurian at the cliff section is a dyke mapped by Selwyn and Aplin as Eurite. These acid dykes range in the Melbourne district from a granitoid texture to a type approaching quartz porphyry, but are always so decomposed that exact determination is impossible. They are doubtfully referred to the Lower Devonian.

Lower Tertiary Leaf Beds.

To the south of Flemington-bridge Station and near Sutton-street occur outcrops of white sands and mottled clays underlying the Older Basalt. These contain leaf remains, but no investigation of them has yet been made. Some

evidence as to the age of the leaf beds is given by bores[6] at Altona, about 8 miles to the south-west, where the surface of the bedrock is more than 600 feet below sea-level. Above this is a considerable thickness of gravelly sands and clays of estuarine and freshwater origin, containing in their upper portion workable seams of lignite. The Older Basalt is wanting, and the lignitic series appears to pass up into blue clays containing a rich marine fauna of Balcombian (Oligocene ?) age. The Sutton-street leaf beds may therefore be approximately equivalent to the lignitic beds of Altona.

Older Basalt.

This antedates the marine Tertiaries, and is therefore referred to the Older period of Tertiary volcanic activity. It rests upon the eroded surface of the leaf beds, and is itself unconformably succeeded by marine Tertiaries, so that its age is dependent upon those assigned to the sedimentary types.

The best exposure is in the Royal Park cutting, where the railway ascends from the valley of the Moonee Ponds Creek through the edge of the escarpment of the Royal Park plateau. Here the basalt has weathered into a mottled clay, which still shows traces of vesicular structure and of spheroidal jointing. Towards the south-west end of the cutting unweathered nodules remain, and the rock has been described by Professor Skeats[7] as a medium-grained ophitic olivine-basalt.

The surface of the basalt in the cutting is very uneven and eroded, and boulders of it are included in the basal beds of the overlying Tertiary sediments. Sections at Brunswick-road and to the south-east of Royal Park show Tertiary sands resting upon Silurian without the interposition of Older Basalt, so that the latter probably occurs infilling an old valley.

Fossiliferous Tertiary Sands and Gravels.

These are best exposed in the Royal Park cutting, where the stratification, though somewhat irregular, is more or less horizontal.

The lowest member, occurring chiefly in the hollows of the Older Basalt, is usually a thin-bedded fine white sand, 4 to 5 feet in thickness. This is overlain somewhat irregularly by a 2-ft. band of ironstone with abundant casts of fossils. The ironstone bed, the lower portion of which is a coarse grit, is not separable from the underlying sands, the uneven junction being mainly due, as stated by Hall and Pritchard,[8] to irregular penetration of the latter by the ferruginous cement. Contemporaneous erosion at the time of deposition of the grit is, however, occasionally to be seen. The fossiliferous band is succeeded by about 25 feet of more or less ferruginous beds ranging from clayey sands to coarse grits with occasional pebble bands. The milky quartz pebbles are derived probably from quartz veins which traverse the Lower Palæozoic sediments of the hinterland, while the angular quartz grains of the

[6] Chapman, Mem. Nat. Mus., Melb., No. 5, 1914, p. 31.
[7] Rept. Aust. Assoc. Adv. Sci., vol. xii., 1909, p. 202.
[8] *Loc. cit.*

grits may be of granitic derivation, perhaps from the Devonian adamellite[9] and granodiorite[10] which outcrop some miles to the north.

The lithological nature of the whole series points to rapid sedimentation in shallow coastal waters, additional evidence of which is given by the occurrence of current bedding and by the littoral aspect of the fauna. Fossils are exceedingly scarce in the upper portion of the series, but a few are recorded by Hall and Pritchard,[11] and are regarded by them as indicating a younger horizon than that of the richly fossiliferous ironstone band. Leaf remains recorded from this locality on the Geological Quarter-sheet probably come from these Upper Beds, and afford further evidence of a contiguous coast-line.

The interpretation of the section and the question of the age of the beds have given rise to considerable differences of opinion.

McCoy,[12] in describing *Aturia australis*, *Haliotis nævosoides*, and *Cerithium flemingtonense* from this locality, assigned them to the Lower Pliocene.

Hall and Pritchard[13] believed on palæontological grounds that two horizons were present, one regarded by them as Eocene (subsequently referred to the Balcombian), and the other as Miocene (later called Kalimnan). The former included the highly fossiliferous band having a largely hematitic cement, together with the underlying white sands, while the latter comprised the overlying limonitic beds. The older beds were believed to occur only in the eroded hollows of the Older Basalt, and overlapping of the younger beds was thought to show evidence of a stratigraphic break.[14]

Dennant and Kitson,[15] in cataloguing the fauna, considered that there was insufficient evidence for the establishment of two horizons, and provisionally referred the beds to the Oligocene.

Chapman[16] has referred the fossiliferous ironstone to the Barwonian,[17] and later[18] to the Janjukian, which he regards as Miocene.[19]

The following list of fossils is exclusive of specific records of doubtful horizon or correctness, and of unpublished determinations:—

Lower Beds.

Anthozoa.

Orbicella tasmaniensis Duncan sp.

Echinoidea.

Echinus (Psammechinus) woodsi Laube sp.

Brachiopoda.

Magellania garibaldiana Davidson sp.

Magellania insolita Tate sp.

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[9] F. L. Stillwell, Proc. Roy. Soc. Vict., vol. xxiv. (n.s.), pt. i., 1911, pp. 161–162.
[10] A. James, *ibid.*, vol. xxxii. (n.s.), pt. ii., 1920, pp. 334–337.
[11] *Loc. cit.*
[12] Prod. Pal. Vict., dec. iii., 1876, pp. 21–22, 27–29.
[13] *Loc. cit.*
[14] See also Pritchard, "Geology of Melbourne," 1910, p. 92.
[15] Rec. Geol. Surv. Vict., vol. i., pt. ii., 1903, p. 89.
[16] Proc. Roy. Soc. Vict., vol. xx. (n.s.), pt. ii., 1908, p. 213.
[17] = Balcombian + Janjukian.
[18] *Ibid.*, vol. xxv. (n.s.), pt. i., 1912, p. 188.
[19] Mr. Chapman refers the Balcombian to the Oligocene and the Kalimnan to the Lower Pliocene.

Pelecypoda.

Cucullæa corioensis McCoy.
Arca (*Barbatia*) *celleporacea* Tate sp.
Arca (*Barbatia*) *simulans* Tate sp.
Spondylus pseudoradula McCoy.
Dimya dissimilis Tate.
Lima bassi T. Woods.
Lima linguliformis Tate.
Lima (*Limatula*) *jeffreysiana* Tate.
Chama lamellifera T. Woods.
Chione cainozoica T. Woods.
Antigona dimorphophylla Tate sp.
Corbula ephamilla Tate.
Corbula pyxidata Tate.

Scaphopoda.

Dentalium (*Fissidentalium*) *mantelli* Zittel.

Gasteropoda.

Patelloida perplexa Pilsbry sp.
Haliotis nævosoides McCoy.
Haliotis mooraboolensis McCoy.
Astræa flindersi T. Woods sp.
Astræa ornatissima T. Woods sp.
Astræa hudsoniana Johnston sp.
Turbo etheridgei T. Woods.
Vermicularia (*Thylacodes*) *conohelix* T. Woods sp.
Siliquaria occlusa T. Woods sp.
Cerithium flemingtonense McCoy.
Cypræa (*Luponia*) *brachypyga* Tate.
Cypræa (*Bernayia*) *subsidua* Tate.
Trivia avellanoides McCoy.
Cassis exigua T. Woods.
Fasciolaria rugata Tate.
Scaphella maccoyi T. Woods sp.
Voluta ancilloides Tate.
Harpa tenuis Tate.
Bathytoma paracantha T. Woods sp.
Bathytoma rhomboidalis T. Woods sp.
Conus (*Leptoconus*) *ligatus* Tate.

Cephalopoda.

Aturia australis McCoy.

Upper Beds.

Pelecypoda.

Nuculana acinaciformis Tate sp
Myodora corrugata Tate.
Dosinia johnstoni Tate.

Gasteropoda.

Leiopyrga quadricingulata Tate.
Tritonidea brevis Tate sp.
Terebra catenifera Tate.
Terebra geniculata Tate.

The above lists show that the fauna of the Upper Beds is of strongly Kalimnan aspect, while that of the Lower Beds is pre-Kalimnan, and may for the present be left as Barwonian.

The cutting has been widened since the date of Hall and Pritchard's paper, and no stratigraphical break can be demonstrated in the sections at present exposed. On palæontological grounds it is probable, however, that a disconformity occurs, but its existence and exact position can be determined only by detailed zonal collecting.

Older High Level Alluvium.

The presence in the valley of the Moonee Ponds Creek of alluvial terraces reaching a height of some 20 feet above the present flood plain appears to point to a recent elevation of that extent. Possibly to be correlated with this is the occurrence[20] in the Altona and Laverton districts of shell-bearing silts overlying the Newer Basalt and indicative of an uplift of at least 10 feet.

Geological History.

The geological history of the area was initiated by the deposition of Lower Silurian (Melbournian) sandstones and mudstones. Folding along axes of meridional trend occurred probably in Lower Devonian times, and was succeeded by the injection of acid dykes, perhaps genetically related to major intrusions of adamellite and granodiorite several miles to the north.

During the Upper Palæozoic and Mesozoic the area constituted a land surface and suffered prolonged erosion.

In the Lower Cainozoic period sedimentation again took place, with deposition of lacustrine sands and clays. The initiation, after a period of erosion, of volcanic activity resulted in a flow of Older Basalt down a valley extending through Essendon, Flemington, and North Melbourne to South Melbourne. After a considerable approach to peneplanation, differential depression of the area resulted in the invasion of the Melbourne district by a shallow mid-Cainozoic sea. Succeeding movements of elevation caused dissection of the coastal plain, leaving outliers of Tertiary sands only upon the higher eminences. When recrudescence of volcanic activity took place in the Late Cainozoic the Royal Park area constituted a hill, so that the Newer Basalt flows did not enter the district.

After the formation of an alluvial plain by the comparatively mature Moonee Ponds Creek, rejuvenation caused by a recent uplift has resulted in the production of terraces at a height of about 20 feet above the present flood plain.

[20] F. E. Grant and E. O. Thiele, Proc. Roy. Soc. Vict., vol. xv. (n.s.), pt. i., pp. 36–40.

2. THE GEOLOGY OF THE BACCHUS MARSH AND COIMADAI DISTRICT.

By Associate Professor H. S. Summers, D.Sc.

(*Thursday, 16th August*, 1923.)

Introduction.

The occurrence of glacial conglomerates associated with sandstones containing *Gangamopteris* has made the Bacchus Marsh District known to geologists throughout the world. Most of the earlier literature deals almost exclusively with the age and origin of the conglomerates, but Dr. Fenner's (79)* recent work has shown that the evolution of the present topography of the area is an intensely interesting and fascinating study. Dr. Fenner gives a list of references dealing with the physiography, but no general bibliography has yet been published, so it has been thought advisable to include one in this publication for the use of those who wish to consult the original papers. This bibliography has been compiled by Miss K. McInerny, M.Sc., who has given substantial help in the preparation of this paper.

Physiography.

The outstanding physiographic features of the Bacchus Marsh area are :—

1. The Rowsley Scarp, which forms the eastern edge of the Ballarat Plateau and up which the train has to climb on its way to Ballan.
2. The famous Werribee Gorge and the deeper, but less known, Lerderderg Gorge.
3. The Bacchus Marsh alluvial basin, containing some of the most valuable agricultural land in the State.

The physiography of the basin of the Werribee River has been very fully described by Dr. C. Fenner (79), and the following notes are largely based on his paper.

The main factors which have controlled the evolution of the present topography of the area are :—

1. Peneplanation of the area.
2. Two periods of tertiary volcanic activity.
3. Two periods of differential uplift.
4. The varied lithological characters of the sediments and associated igneous rocks.

Peneplanation.

The last cycle of peneplanation was completed about the beginning of the Tertiary Period†, and indicates a fairly prolonged period of still-stand since the whole area had been reduced to a farily uniform level. This early tertiary peneplanation seems to have been an important physiographic feature throughout Australia.

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* Numbers in brackets refer to literature quoted at end.

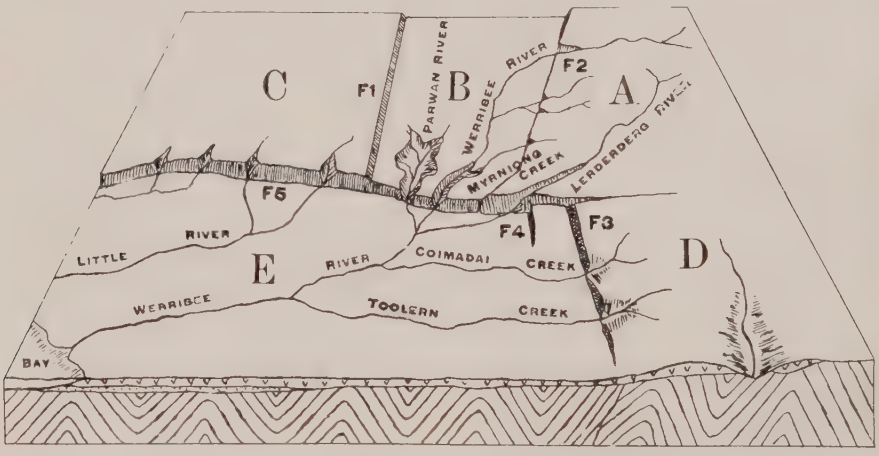
† Dr. Fenner places the completion of peneplanation at the beginning of the Miocene, but for reasons given later it is believed that it was completed at an earlier date.

Older Volcanic Activity.

The Older Basaltic eruptions occurred about the same time as the initiation of block uplifts in the area, but undoubtedly preceded the main movement along the older faults, since, near Greendale, the Older Basalt has been faulted against the Ordovician. The present outcrops of the Older Basalt are practically confined to what Dr. Fenner has called the "Ballan Sunkland," and it may be inferred that erosion has removed the Older Basalt from the raised blocks, whereas it has been protected in the sunkland. In the accompanying map a large area of Older Basalt is shown along the Korkuperrimul Creek.

Earlier Block Faulting.

In the block diagram (after C. Fenner) which is given below, the principal faults and fault blocks are shown. The first movement of differential uplift caused the formation of two east and west faults known as the Greendale fault and the Spring Creek fault. Dr. Fenner's diagram shows these faults



A LERDERDERG RANGES.
B BALLAN SUNKLAND.
C BRISBANE RANGES.
D GISBORNE HIGHLANDS.
E WERRIBEE PLAINS.

F1 SPRING CREEK FAULT
F2 GREENDALE FAULT.
F3 GISBORNE FAULT.
F4 COIMADAI FAULT.
F5 ROWSLEY FAULT.

BLOCK DIAGRAM OF THE WERRIBEE BASIN. AFTER C. FENNER.

ending abruptly where they meet the later north and south Rowsley fault. In his paper he states (p. 231) that the Greendale scarp meets the Rowsley scarp, and "the consequence of this is, of course, that the northern continuation of the Rowsley fault has a much greater throw than further to the south."

This statement is rather unconvincing, since if only one movement took place along the Rowsley fault, then the fact that it met an older fault seems hardly capable of explaining the real or apparent difference in throw to the north and south of the junction. No explanation is given of the abrupt ending of the Greendale and Spring Creek faults where they meet the Rowsley fault. Two alternative explanations are as under :—

1. The Lerderderg block was uplifted with concurrent faulting along the Greendale fault and a first movement along that part of the Rowsley fault, north of its junction with the Greendale fault. Similarly, the Brisbane Ranges block was elevated with the formation of the Spring Creek fault and the southern part of the Rowsley fault. This postulates the existence of two independent north and south faults, which, however, were on the same general line. At a later period differential uplift again took place, and the country to the west of the Rowsley scarp was elevated. This would result in further movement along the two north and south faults ; but as the Ballan block was also raised, a connecting fault would be formed joining up the previously independent faults into one long fault line.

2. Alternatively it is suggested that the Greendale fault and the Spring Creek fault did not end abruptly at the points shown by Dr. Fenner, but extended eastward and gradually died out. The Greendale fault should then have crossed the valley of the Lerderderg, and an extensive fan delta on the down-throw side of the fault would result. Later movement along the Rowsley fault would also cause the deposition of a fault apron along the foot of that scarp, and it is suggested that these combined deposits have masked the old fault scarps, so that they cannot be traced eastward of the Rowsley fault line.

In either case a fault scarp would cross the Lerderderg Valley, and the upper part of that stream would be rejuvenated. This differs from Dr. Fenner's view in that he does not suggest any rejuvenation of the Lerderderg until the *post*-Newer Basaltic movement along the Rowsley fault.

Excellent examples of fan deltas are found along the foot of the Greendale scarp. These were formed by comparatively small streams, and yet are of considerable extent. Since the Lerderderg is a much more powerful stream, if it were rejuvenated, as suggested, then the fan delta formed would be correspondingly larger and so extend over a fairly wide area. The possible bearing of the presence of such a fan delta on the subsequent formation of the Bacchus Marsh basin is discussed later.

Dr. Fenner believes that the Gisborne and Coimadai faults belong to the same period as the Greendale fault.

The natural corollaries to differential uplift are the dissection of the raised blocks and deposition on the sunk lands. Fault aprons were formed along the bases of the scarps, but further away from the fault lines swampy or lacustrine

conditions probably existed, and deposition of the tertiary sands and leaf-beds took place. Naturally these tertiary deposits are confined to the sunklands.

Newer Volcanic Activity.

Subsequent to the earlier uplift with its consequent dissection of the raised blocks with concurrent deposition on the sunken blocks, the basalts of the Newer Volcanic series were poured out from many centres and covered the greater part of the sunklands. Basalt is also found on the raised blocks, but is less widely distributed. In several places flows cross the Greendale, Coimadai, and Gisborne faults, and the basalt shows absence of disturbance, indicating that the lava flows are younger than these faults.

On the other hand the basalt on either side of the Rowsley fault shows great difference in level, and from this it is inferred that the fault movement is in part, at least, younger than the basalt flow. The somewhat uneven sub-basaltic surface, as for instance at Dog Trap Gully, on the upcast side of the fault, suggests that uplift, probably small in amount, had taken place before the lava flow. This uneven surface may have been due to dissection caused by general uplift or by the initial differential uplift along the Rowsley fault. Generally where the lava flowed along pre-existing stream courses the old beds were buried, and two new streams, "twin streams," were formed: one on either side of the basalt tongue. R. A. Keble uses the term "laterals." A good instance of this feature is that of the flow from Mount Bullengarook, which filled up the ancient "Bullengarook River" and led to the production of the twin streams, Goodman's Creek and Coimadai or Pyrete Creek. The road from Bacchus Marsh to Coimadai passes over this flow. In areas completely buried by the lava the stream courses were obliterated, and entirely new beds had to be formed. Thus most of the present-day valleys are younger than the Newer Basalt flows. An important exception is the upper part of the Lerderderg, in which no basaltic flows occurred.

Prior to the Greendale fault movement the Lerderderg River probably flowed in the same general direction as at present, and its valley was incised owing to rejuvenation, the result of the first movement of uplift. Further deepening of the gorge followed the later differential movement along the Rowsley fault.

Later Block Faulting.

Following the flows of Newer Basalt, further movements of elevation took place, and the area to the west of the Rowsley scarp was raised. Dr. Fenner examined this scarp along a considerable portion of its length, and concluded that it was mainly formed by simple faulting, but that a series of step faults or a monoclinal fold may have replaced the simple fault in the neighbourhood of Bacchus Marsh. The area to the east of the Rowsley fault and extending to the Mornington Sorrento fault (Selwyn's fault) forms the Werribee Plains sunkland, or using a wider term, the Port Phillip sunkland, which consists mainly of low-lying basalt plains with the drowned area of Port Phillip.

With the rejuvenation of the streams, consequent on the movement of uplift, gorges would be cut in the raised blocks. The Lerderderg, as a result of the previous uplift, had already cut a gorge into the Lerderderg Block, and, in consequence of renewed uplift, was enabled to deepen its gorge. At the present time the valley above the Rowsley fault line is as much as 1,000 feet in depth with in places practically vertical walls 500 to 600 feet high.

The ancestor of the Werribee had been buried by flows from the neighbourhood of Ballan and Ingliston, so that the greater part of the upper valley of the present Werribee has been formed since the Newer Basaltic flows. By means of headward erosion the Werribee has cut a deep gorge some distance back from the Rowsley scarp. On the basalt plateau, near Ballan, the valley is not deeply incised, and down stream from this point the main gorge is entered where the Werribee crosses the Ingliston adamellite. Down stream the rocks consist mainly of indurated Ordovician sandstones and shales, and here the gorge has very steep sides, in places over 600 feet deep, and this part of the valley consists of a succession of entrenched meanders. Continuing down stream glacial beds appear, resting on the eroded surface of the Ordovician. At first these beds are seen high up the sides of the valley, but farther east pass below river level. These glacial beds, and also the Tertiary sands which occur lower down the valley, were much less resistant, and the gorge rapidly gives place to a wider, more open valley. A flat-topped hill, commonly known as "Trig Hill," occurs in this part of the valley. It is capped by Newer Basalt overlying Tertiary leaf-beds and Older Basalt, and forms an outlier of the main Newer Basalt flow to the south.

The Myrniong Creek joins the Werribee just below the adamellite-Ordovician junction, and they form twin streams, *i.e.*, they flow on either side of the basalt tongue which buried the ancestral Werribee. The narrow, flat-topped, basalt-capped area just above the junction is known as "The Island."

The Parwan with its tributary, the Yaloak, has also carved out in the raised block a *post*-Newer Basaltic valley. This valley is cut in extremely soft horizontally bedded Tertiary sands and clays underlying a thin basalt covering. Once the basalt was cut through the valley was rapidly widened till now there is an irregular basin 4 miles across and 8 miles long and about 500 feet deep, descending sharply from the surrounding basaltic plains. Land-slips giving a characteristic hummocky surface are a feature of this basin.

Along the foot of the Rowsley scarp the Newer Basalts are largely covered by recent gravels, sands, &c. These represent fault apron deposits.

The Bacchus Marsh Basin.

This is one of the most striking physiographic features of the area, and is also one of the most difficult to explain. The basin contains about 4,500 acres of irrigable lands, and consists of a level plain of deep alluvium, across

which the Werribee and Lerderderg Rivers meander. To get away by road from the township of Bacchus Marsh, which lies in this basin, it is necessary to ascend the surrounding escarpment. The stream makes its exit at the south-eastern end of the depression through a narrow gorge cut in the basalt. No satisfactory explanation of the formation of these flats has been published. The following hypothesis is new and is put forward with the object of arousing discussion on this difficult problem.

One of the earliest differential movements in the area was along the Greendale fault. This fault is shown in Dr. Fenner's diagram as ending at the later Rowsley fault. For reasons given earlier, it is believed that this fault extended eastward of this line and consequently crossed the valley of the Lerderderg River, or alternatively that the Lerderderg crossed the scarp formed by the uplift along the northern part of the Rowsley fault which took place concurrently with the movement along the Greendale fault. This would cause the rejuvenation of the Lerderderg above the fault line, and an extensive fan delta was formed on the down throw side of the fault. This fan delta would be higher than the general level of the depressed area, and it is conceivable that the Newer Basaltic flows covered only the less elevated parts of the alluvial fan. The probable course taken by the Lerderderg River would be along the north and north-east junction of the fan delta with the basalt and that of the Werribee along the southern junction. These streams and the Parwan joined one another near the south-eastern margin of the fan delta and found an exit over the basalt. Since the stream where it crossed the basalt was rejuvenated to a limited extent owing to the increased elevation due to the thickness of the basalt flow, the stream has cut a narrow gorge through the basalt rim which surrounds the basin. During the time occupied in cutting through this barrier the streams would meander about behind the barrier dissecting and resorting the unconsolidated material of the fan delta and depositing fresh material brought down from the block to the west which had been raised by the movement along the Rowsley fault. The lateral swing of the streams would tend to enlarge the basin by cutting into the soft fan delta material underlying the basalt.

Along the western slopes of the basin thick beds of boulders and gravel are fairly abundant, and may well represent portions of the old fan delta which have not been removed by subsequent erosion. At present the Werribee and Lerderderg flow along narrow channels, and the stream level is from 15 to 20 feet below the general surface of the basin. The banks are formed of almost vertical walls of alluvium. This may indicate a recent uplift; the deepening of the outlet from the basin; or the removal of some obstruction from the lower part of the stream. The meandering streams are cutting into the banks and destroying valuable flats, and one meander of the Lerderderg is rapidly eating back towards the main Melbourne road and threatening it with destruction.

General Geology.

(*a*) *Ordovician.*

The bed rock of the whole area shown on the accompanying map consists of sandstones and slates of Lower Ordovician age. The following notes on the fossils recorded from these rocks have been supplied by Mr. F. Chapman :—

The fossiliferous rocks of the Lower Ordovician are exposed in the Werribee Gorge, on the banks of the Lerderderg River, and in the Korkuperrimul and Parwan creeks.

The earliest identifications of graptolites from the Bacchus Marsh District were made by Sir F. McCoy, on Geological Survey specimens, now in the National Museum collection. They are :—

Tetragraptus bryonoides J. Hall sp.[1] Creek west side of Lerderderg, 3 miles[2] north-west of McLeod's Station (Lancefield Camp). Bd4.

Tetragraptus octobrachiatus J. Hall sp. Branch of Parwan Creek. Bd2.

Phyllograptus typus J. Hall. Branch creek, west side of Lerderderg. Bd5. Also Lerderderg River, 3 miles north-west of MacLeod's Station. Bd4.

See Prod. Pal. Vict., Decade I., 1874.

In a list of Victorian graptolites published by Dr. T. S. Hall in 1898 (Prog. Rep. Geol. Surv. Vict., No. IX., pp. 126, 127), the following graptolites, of Bendigonian age, are recorded :—

Dichograptus octobrachiatus J. Hall sp. Branch of Parwan Creek (G.S.V., Bd2).

Phyllograptus typus J. Hall. Lerderderg River.

Tetragraptus quadribrachiatus J. Hall sp. Coimadai.

Tetragraptus serra Brongn. sp. Parwan Creek.

Didymograptus caduceus Salter. Parwan Creek.

Didymograptus extensus J. Hall, sp Parwan Creek.

Beside the above fossils I have identified *Hymenocaris* sp. from survey specimen Bd3, Werribee Gorge, half-a-mile south of junction with Myrniong Creek, and I have collected *Rhinopterocaris maccoyi* Eth. fil. sp., from the same locality.

To the records given by Mr. Chapman may be added the occurrence of broad forms of *Didymograptus caduceus* from a road-cutting west of Gatehouse 24.

Splendid sections for the observation of the structural features of the Ordovician rocks are exposed along the Werribee Gorge, and in road and railway cuttings westward of Gatehouse 24 on the Ballarat line. Mr. Brittlebank (46) found that in the gorge the strike of the beds is generally N. 10° E.,

[1] This record requires further comparison with related forms, as *T. serra* and *T. similis.*

[2] Not 2½ miles, as recorded in Prodromus.

with dips ranging from 30° to 90°. The dips to the western legs of the folds average 10° to 20° higher than to the eastern legs. Very fine examples of anti-folds are exposed in the section known as "Daintree's Cliff." Almost opposite the lower shelter shed a somewhat abnormal feature may be seen. A small stream has cut its bed in the axis of a synclinal and enters the Werribee from a hanging valley.

In the road section, about 20 yards north of the railway crossing at Gatehouse 24, a fine example of "concertina folding" is exposed. Anticlines, synclines, minor faults, intrusive dykes, &c., are well developed in the cuttings near this point. These folds generally have a fairly steep southerly pitch.

(b) *The Adamellite and Associated Dykes.*

The age of the adamellite can only be approximately determined. It is intrusive into the Lower Ordovician series, and its eroded surface is in part overlain by the Permo-carboniferous glacial beds. It is generally accepted as belonging to the Lower Devonian period. The rock exposed in a railway cutting near Ingliston has been analysed (7) and also examined microscopically. It consists of quartz, biotite, with orthoclase and plagioclase in almost equal amounts. The mineralogical and chemical composition indicate a rock intermediate between granite and granodiorite, so that it conforms to Hatch's definition of adamellite. At the bottom of the gorge (100 feet lower elevation) biotite is much more abundant, and the rock is more basic and probably more nearly approximates to a granodiorite. Near the contact with the Ordovician series numerous fragments of the sedimentary rocks are to be seen included in the plutonic rock. Mr. Brittlebank (8b) has published the following statement:—"At the actual junction the granite has invaded the Silurian (= Ordovician) along the bedding planes and joints . . . . Small slabs of quartzite, sandstone, and nodular clay-slate are observed at some distance from any known contact point, and . . . . . they still retain the normal dip and strike." At the junction the Ordovician rocks exhibit marked contact metamorphism. The strike of the sedimentary rocks near the contact shows no material change, and the adamellite appears to have reached its present position by overhead stoping. In one of the railway cuttings east of Ingliston acid apophyses are seen penetrating the Ordovician sediments. Near Gatehouse 24 a decomposed acid dyke with a north and south trend has cut through and altered the slates, chiastolite being developed. Just below Pyramid Rock a fairly fresh quartz porphyry dyke crosses the Werribee, and owing to its resistance to wear the gorge narrows at this point. Mr. Brittlebank (8a) has recorded a striated surface to this dyke in contact with the overlying glacial beds, thus establishing its age as Pre-Permo-carboniferous.

(c) *The Glacial Series.*

These beds consist of true tillites together with conglomerates and fine sandstones of fluvio-glacial origin. Selwyn (1) was the first to suggest in 1861 their glacial origin, and in 1866 Daintree (2) recorded the presence

of striated pebbles, but the earliest record of evidence, which proved beyond doubt the glacial origin of this series in Victoria, was in a report by E. J. Dunn (32) on Wild Duck Creek, published in 1892.

The following notes on the flora of the sandstones have been supplied by Mr. F. Chapman :—

> The sandstone of Bald Hill contains a fairly abundant flora, but not rich in species. The majority can be referred to the Pteridosperm, *Gangamopteris*.
>
> McCoy, in his Prodromus of Palæontology of Victoria, Decade II., 1875, records three species—
>
> *Gangamopteris angustifolia* McCoy (previously recorded from New South Wales).
> *G. spatulata* McCoy.
> *G. obliqua* McCoy.
>
> G. B. Pritchard has more recently (Proc. Roy. Soc. Vict., Vol. XXII., pt. II., 1909, p. 261) described stems and leaf impressions from "the lower *Gangamopteris* quarry overlooking the Korkuperrimul Valley," as *Calamites Macnabi*.
>
> NOTE.—The *Gangamopteris* flora may be generally regarded as representing a lower horizon of the Gondwana series than the *Glossopteris*.

Distribution in Victoria.—Glacial beds of Permo-carboniferous age are well developed in the country between Bacchus Marsh and Ballan ; in the Western District near Coleraine ; near Keegan's Ford, west of Kyneton ; at Derrinal and Knowsley (Wild Duck Creek), north-west of Heathcote ; underlying the deep leads at Charlotte Plains; and Mr. D. J. Mahony has recognised glacial material in some of the bore-cores from the Mallee. Isolated patches are fairly common in north-eastern Victoria, near Glenrowan, Greta, Chiltern, and Beechworth.

Glacial Pavements.—Numerous glaciated pavements have been recorded in the Bacchus Marsh and Coimadai District, the more accessible being—

(i) In the bed of the Werribee, just below the lower shelter shed and about opposite the synclinal valley.

(ii) About 7 yards to the east of a small tributary which enters the Werribee from the north, about one-third of a mile below the lower shelter shed. The pavement is about 10 yards from the main stream.

(iii) "Wightman's Rock." This is a fairly large outcrop above the east bank of the Coimadai Creek in allot. 18, Parish of Merrimu.

(iv) The "Pyrete Twins." These are two splendid examples of grooved and striated pavements, and show tillite packed into the hollows in the surface. They outcrop about about 200 yards south of Wightman's Rock in the bed of the Pyrete or Coimadai Creek.

A [illegible] of vacuum moraine was discovered in the Pleistocene sandstones at Price's Reserve by Dr. F. Stilwell in 1953. This indicates a re-advance at the ice sheet.

Although these movements are all good, "Dunn's Rock," in the Portland area, is really the finest example of a glaciated surface in Victoria.

[illegible] The [illegible] glaciated pavements have been the ice moved in a north-easterly direction, and so rather than high land that existing to the west or south-west of Tasmania. This is evidenced by the direction of glacial striations and by the direction of the "plucked," i.e., the rotational gouging below the general level of the smoothed rock surface.

The Conglomerates. Most sections of tillite are covered in the area, notably in the Cranbourne district. The tillite consists of boulders, many of which are faceted or striated, set in a fine gravel matrix. The matrix sometimes the larger proportion of the rock. The boulders vary greatly in size and are exceedingly diverse in composition. Many Cambrian chert, many varieties of granite, porphyry, gneiss, schist, quartzite, &c., are obtainable. Some rock types not known to occur in Victoria are present in these boulders. [illegible] the upper shales and in the Cranbourne area. Near Cranbourne [illegible] and along the gorge good specimens are rare. In many parts of the area, notably in an old glacial valley exposed in the upper part of the gorge, the conglomerate shows, generally, a coarser texture, and the proportion of pebbles and boulders to matrix is higher than in the rocks described as tillites. These conglomerates probably represent material more or less sorted by glacial rivers and so are best described as being of fluvio-glacial origin.

Sandstones. The sandstones are best developed at Bald Hill, about 2 miles north-west of Berwick Marsh, and in Cranbourne's Creek, Police Quarry, about [illegible] west of Cranbourne. Quarries have been opened at both these places and examples of the same sediments may be seen in the Cranbourne Shire at Berwick Marsh and in the old Tramway Buildings at Cranbourne. Melbourne [illegible] sandstone shows [illegible] a conglomerate of small, well-rounded pebbles and grains set in a fine-grained matrix. The same grains are rarely in contact with one another, being in the form [illegible] of larger rounded grains. The [illegible] sandstone probably was formed in a fine-grained [illegible] some 75 ft. These sandstones were probably deposited in a glacial lake and in the lower layers at Bald Hill a pebble consisting [illegible] has been matched in the action of scratching ice.

Messrs. Swan and Brunnschweiler have stated that all the glacial beds [illegible] and that in the [illegible] a north-easterly direction, and range from 10° to 15° north-eastwards by west to [illegible] 30°. Further [illegible] that the tillites show no stratification [illegible] and conglomerates and [illegible] with one another, and [illegible] particularly well-developed. The sandstones at Bald Hill are [illegible] and [illegible] the sandstones.

(d) Triassic Sandstones.

In a cutting in the slopes of Bald Hill plant remains have been found, which are distinct from the *Gangamopteris* flora. Mr. F. Chapman has contributed the following note:

TRIASSIC

McCoy, in 1892 (Ann. Rep. Dept. Mines, Vict., for 1891), recorded the genera *Schizoneura*, *Ptilophyllum*, and *Zeugophyllites* (= *Phoenicopsis*), in dealing with the Geological Survey collections.

McCoy also described, in 1898, *Tæniopteris Sweeti* from Bacchus Marsh. This plant I have lately stated (Vict. Naturalist, Feb. 1919, p. 149) to be identical with *T.* (*Macrotæniopteris*) *wiannamattæ* Feistmantel, and the matrix shows it to be Triassic and not Carbopermian as before supposed. (See Newell Arber, Glossopteris Flora, Brit. Mus., p. 128.)

McCoy later specified the *Ptilophyllum* as *P. Officeri* (Proc. R. Soc., Vict., Vol. VI., 1894, p. 143), but this I have lately determined as identical with *P. oligoneurum* T. Woods, which is itself synonymous with *Ptilophyllum* (*Williamsonia*) *pecten* Phillips sp.

These interesting plant remains occur in a trench made in the Council paddock at Bald Hill, in some narrow bands of about 6 inches thick, of silicified or cherty mudstones, in places almost like porcellanite.

The writer has a memoir on these and additional specimens of plant remains ready for publication by the National Museum. The work deals with fifteen genera and eighteen species.

(e) Sub-Older Basaltic Deposits.

Sub-Older Basaltic river gravels have been noted in several parts of the area, and at the base of two outcrops of Older Basalt on either side of Trig Hill fragmental beds (? volcanic) containing obscure leaf impressions have been located by Mr. C. Brittlebank.

(f) The Older Volcanic Series.

The best exposures of Older Basalt are along the Korkuperrimul Creek. The rock is frequently in a more or less advanced stage of decomposition, but some of the non-vesicular material is quite fresh. A peculiar form of weathering has been noted by Professor Skeats in an outcrop in the bed of the creek about 1¼ miles above the bridge on the Ballarat road. Weathering has commenced from closely-adjoining cracks in the rock, and the material bordering these rocks has been converted to a reddish clay, leaving angular cores of fresher rock. The general appearance of the rock is that of an agglomerate, and it was at first regarded as such, but on a careful study of its relationship to the surrounding rocks its true nature was determined. Just at this point two almost vertical monchiquite dykes intersect the main mass, and the smaller

considerably in texture from fine-ground dense forms to coarse vesicular types. Phenocrysts of augite and occasionally hornblende have been noted, and the zeolite thalsenite occurs in a small patch of somewhat decomposed vesicular material. Professor Skeats [3] has recorded an olivine augite andesite from the Older Basalt series, but unfortunately the exact locality of the specimen is unknown. Probably belonging to a late stage of the Older Volcanic series are a number of monchiquite dykes commonly with an east and west trend. Several of these dykes may be seen in Goodman's Creek, penetrating the glacial beds. In no case have they been found intrusive into the Tertiary leaf beds.

(2) The Tertiary Leaf Beds.

Overlying the Older Basalt, and also resting on the Palæozoic rocks, are a series of more or less horizontally stratified beds. These vary greatly in [illegible] and include [illegible] sands and clays, [illegible] ferruginous sandstones and sandstones, and almost pure deposits of limonite. Lignites occur at Bacchus Marsh and in several places to the westward, notably at Leaf Lane. In the ferruginous sandstone beds and lignites and clays of [illegible], are fairly common. Mr. Chapman writes as follows:

Two species of angiospermous leaves were described by McCoy in 1876 (Prod. Pal. Vict., Decade IV., viz. *Cinnamomum polymorphoides* on the "red and yellow ironstone," 2 miles west of Maddingley and at half-a-mile north-west of the junction of the Werribee and Lerderderg rivers, and *Banksia* in the ferruginous beds at a quarter of a mile north-west of the junction of the Werribee and Lerderderg rivers.

[illegible] has also been recorded from the Cainozoic of Portland Plains, Victoria. *Cinnamomum polymorphoides* occurs also at Portland Plains and Nareeran.

These beds are confined to the sunken blocks of Ballan and the Werribee Plains. The lignites are near the base of the series and were evidently laid down in lakes and swamps produced by the first differential movement [illegible]. The [illegible] probably owe their origin to the same cause; but in this case the downward [illegible] was followed by a subsequent upward movement, so that the [illegible] lignites were succeeded by [illegible] beds. [illegible]. Marine conditions [illegible] from the [illegible] were [illegible] Bacchus Marsh.

[illegible] the [illegible] and the [illegible] still [illegible]. For this reason it is suggested that [illegible] Lower Tertiary and not in the Miocene, as suggested by Dr. Penner.

Distance from the fault scarps has been the principal factor governing the grain size of the Tertiary beds in the area under discussion. Along the foot of the Greendale scarp, particularly where the streams cross the fault line, heavy gravels containing numerous large boulders are common, whereas along the Parwan and Werribee, just above the Rowsley fault, the deposits consist mainly of clays and fine sands, with an entire absence of heavy gravels. To the east of the Rowsley fault, beds of pebbles and boulders are fairly widely distributed, especially to the west and north of Bacchus Marsh. The relationship of these beds to the Newer Basalt has not been thoroughly worked out. Some undoubtedly are younger than the Newer Basalt, but others are probably pre-basaltic, and so are older than the later movement along the Rowsley fault. The coarseness of the material indicates that it was deposited close to a fault scarp, and it is believed that it is part of the fan delta of the Lerderderg when it was rejuvenated at the first period of differential uplift.

(*h*) *The Newer Volcanic Series.*

The Newer Basalt is the most wide-spread surface rock of the area, and covers practically the whole of the Werribee plains sunkland and a fair proportion of the Ballan block, while tongues of basalt are found on the uplifted blocks of the Lerderderg and Brisbane ranges.

(*i*) *Post-Newer Volcanic Gravels, Sands, and Alluvium.*

The gravels and sands are found principally along the western edge of the Werribee plains sunkland, and constitute the Rowsley fault apron. Alluvium has been deposited along the courses of streams, such as the Parwan and Werribee, above the Rowsley scarp. The streams below the scarp have recently cut, or are in process of cutting, their courses through the basalt, whereas above the fault-line they have long since cut through the hard basalt cap and into the softer underlying rocks. This has enabled them to reach grade and to deposit alluvium along their valleys. Below the fault scarp recent alluvium is found in the Bacchus Marsh basin, the origin of which has been discussed earlier.

(*j*) *The Coimadai Limestones.*

At the township of Coimadai, in the valley of the Pyrete or Coimadai Creek, are small outcrops of a dolomitic limestone. These occupy hollows in the Tertiary sands. Bands of volcanic ash have been recorded as occurring interbedded in the limestone. Fossil bones are commonly found, and the following forms have been recorded by Mr. De Vis (50) :-

Phascolomys parvus Owen.
Halmaturus dryas De Vis.
H. anak Owen.
H. cooperii Owen.

These forms indicate a Pleistocene age. The relationship of these limestones to the Newer Basalt has not been determined, and consequently no attempt has been made to place them in their proper sequence.

Outline of the Sequence of Events in the Geological History of the Area.

1. Deposition of the Lower Ordovician sediments under marine conditions.

2. Uplift at the close of the Lower Ordovician and folding along north and south axes, with probable further folding along the same general direction at the close of the Upper Ordovician and of the Silurian periods. Numerous reversed strike faults formed concurrently with the folding.

3. During the Lower Devonian period intrusion of adamellite by means of overhead stoping. North and south acid dykes intruded along reversed fault planes and other fracture lines.

4. Denudation and exposure of adamellite and dykes at the surface.

5. Invasion of the area in the Permo-Carboniferious period by an ice sheet from high lands, then situated to the west or south-west of Tasmania. This ice moved in a north-easterly direction, grooving and striating the underlying rocks. Tillite deposited in the form of a ground moraine. Deposition of fluvio-glacial conglomerates and sandstones by glacial rivers and in glacial lakes. The sandstones indicate recession of the glaciers, but glacial pavements, such as one found by Dr. F. Stillwell in the sandstone near Pyke's reservoir, indicate re-advance of the ice. The *Gangamopteris* flora indicate the advent of milder conditions.

6. Deposition of Triassic sandstones, apparently conformable to the underlying *Gangamopteris* beds.

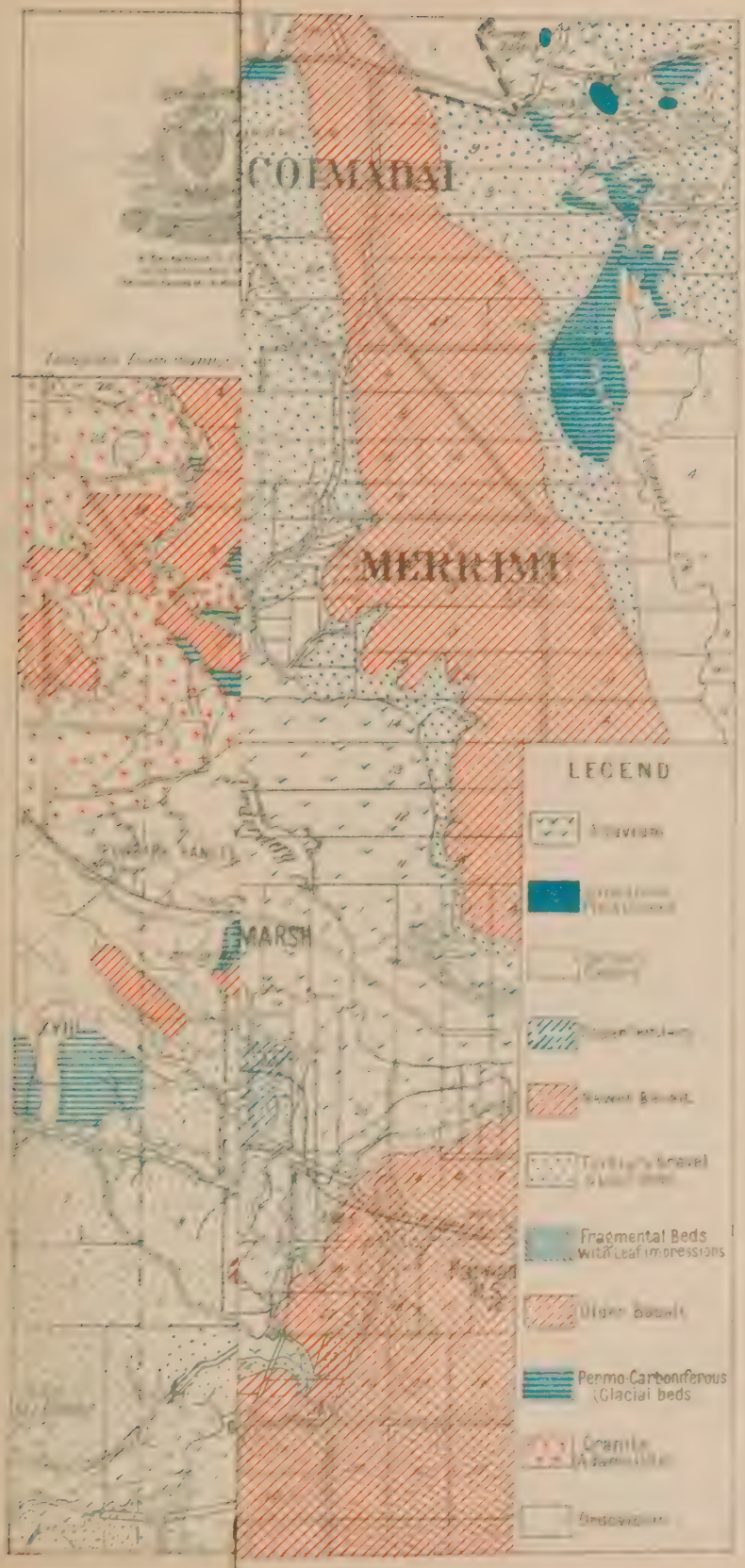
7. Possible earlier movements, as suggested by Dr. Fenner, along the Greendale and Spring Creek fault lines, letting down the Ballan block, and so protecting the glacial beds thereon from complete removal during the interval between the Triassic and Miocene periods.

8. Latest cycle of peneplanation about complete in the lower to middle Tertiary period.

9. Outpouring of flows of Older Basalt, followed by the intrusion of monchiquite dykes into the Older Basalt and underlying rocks. These dykes were generally intruded along east and west normal fault planes or other lines of fracture.

10. Differential uplift along the Greendale, Spring Creek, Gisborne, and Coimadai faults producing the raised blocks of the Lerderderg ranges, Brisbane ranges, and Gisborne highlands, and also the sunklands of Ballan and the Werribee Plains.

11. Dissection of the raised blocks. Deposition of boulders and coarse gravel as fault aprons along the scarps and the deposition at some distance from the fault lines of lignites, and fine sediments with leaf impressions in lakes and swamps.


COLMANAI
MERRIMI
MARSH
LEGEND
Fragmental Beds with Leaf Impressions
Permo-Carboniferous (Glacial beds

GEOLOGICAL SKETCH MAP OF THE BACCHUS MARSH DISTRICT

W. Baragwanath, Director.
A.H. Merrin, Secretary for Mines.
The Hon. S. Barnes, M.L.A. Minister of Mines.

Scale, 1 Mile to 1 inch

Railway levels thus, 690·7 Aneroid levels thus, 700'

Compiled from manuscript maps by R. Daintree, C.S. Wilkinson, R.A.F. Murray & C.C. Brittlebank, & Quarter Sheet N°2 N.E.

COIMADAI

MERRIMU

DARLEY

KORKUPERRAMU

BACCHUS MARSH

PARWAN

ROWSLEY

GORROCKBURNE HAT

IRONBARK RANGES

GORGE

LEGEND

- Alluvium
- Limestone Pleistocene
- Tertiary Capping
- Upper Tertiary
- Newer Basalt
- Tertiary Gravel & Leaf beds
- Fragmental Beds with leaf impressions
- Older Basalt
- Permo-Carboniferous (Glacial beds
- Granite (Adamellite)
- Ordovician

12. Newer Basaltic eruptions covering practically the whole of the Werribee plains block, with the exception of the relatively high ground forming the fan delta of the Lerderderg. The flows also covered a large portion of the Ballan block with tongues on the raised blocks.

13. Post-Newer Basaltic movement along the Rowsley fault. Increased dissection of the Lerderderg and Brisbane blocks bringing them to their present condition of deeply-dissected peneplains. Deepening of the Lerderderg gorge. Initiation of dissection of the Ballan block leading to the formation of the Werribee gorge and the Parwan basin. Deposition of fault apron along the base of the Rowsley scarp. Dissection and removal of the greater portion of the Lerderderg fan delta and deposition of the recent alluvium of the Bacchus Marsh basin. Deposition of alluvium along the Parwan, Werribee, &c., just above the Rowsley fault.

14. Recent deepening of the Werribee valley below the Bacchus Marsh basin, and consequent dissection of the alluvial flats by the Werribee and Lerderderg rivers.

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3. THE GEOLOGY OF STUDLEY PARK.

By H. B. Hauser, B.Sc.

(*Friday*, 17*th August*, 1923.)

Introduction.

The area is situated about 3 miles to the north-east of the city of Melbourne, and is a part of the quarter-sheet No. 1, N.E. (Melbourne). It was originally surveyed under the direction of A. R. C. Selwyn, Government Geologist, and was included in Unwin's special survey.

The literature on the area is scarce, consisting of notes of excursions held by the Victorian Field Naturalists' Club, and occasional references to the fauna of the Silurian and Cainozoic sediments.

General Geology.

The following formations are represented in the area :—

Recent ..	..	.. Alluvium
Cainozoic	..	.. Newer Basalt
		Sands and gravels
		Lamprophyric dykes
Palæozoic—Silurian		.. Sandstones and mudstones

Silurian.

The Silurian, occurring as the base rock over all the Melbourne district, consists of interbedded sandstones, mudstones, and shales, varying greatly in colour and coarseness. Fairly extensive palæontological work has been done on these rocks, and a detailed list of the Victorian Silurian fauna has been published.[1]

The fossils recorded from Studley Park are few in number and consist of—

Anthozoa	..	.. cf. *Streptelasma*
Hydrozoa	..	.. *Monograptus* sp.
Brachiopoda	..	.. *Camarotœchia decemplicata* Sow. sp.
		Chonetes melbournensis Chapm.
Gasteropoda	..	.. *Loxonema* sp.

These are found in the section along the road leading from Johnston-street bridge to Dight's falls and on the ridge above the falls. *Monograptus* sp. occurs in the cutting in thin mudstones, interbedded with sandstones, about 100 yards from Johnston-street bridge.

The Silurian rocks have been divided into the lower or Melbournian series, and the upper or Yeringian series. Only the Melbournian series is represented in this area, and the absence of the Yeringian is to be associated with erosion of the Silurian rocks in the broad Whittlesea anticline. While fairly open folds

[1] Chapman, F. Aust. Assoc. Adv. Sc., Melbourne, p. 208, 1913.

are the rule, within each broad anticline are occasional crush zones showing close folding, overfolding, pitching folds, and reversed faulting. The Victoria-street and Studley Park cuttings occur in such a crush zone and show these structural features admirably.

In the crush zones at Studley Park quartz veins fill up small joints in the rock. The deposition of these veins is probably contemporaneous with the folding, and probably occured during the Lower Devonian period.

The fossils of the marine Silurian sediments often occur only as moulds or casts, owing to their decalcification.

The interbedding of relatively coarse sands with fine shales suggests either frequently recurring flood conditions or variation in the strength of the current during the laying down of these sediments. The relative thinness of the beds, which are seldom more than 18 inches thick, and the rapid alternation of sandstones and mudstones, tend to support these views. The occurrence of thin alternating sediments, with strongly marked current bedding and well-developed ripple marking in the sandstones, is indicative of fairly shallow water conditions during deposition. The nearest evidence of a Silurian shoreline is found at Keilor, about 10 miles to the north-east, where Silurian conglomerates occur.

Detailed study of the sediments indicates two probable sources for the origin of the material—(1) A pre-Silurian igneous rock. (2) A series of pre-Silurian sediments. Detailed microscopical investigation points to the material being derived from both sources.[1]

Dykes.

Intersecting the Silurian rocks at Studley Park are numerous instances of intrusive rocks occurring as dykes or sills. These are also very well exemplified in the two cuttings mentioned above. The original dyke rock is now thoroughly decomposed into a whitish clay. They are probably basic lamprophyre dykes, as fresh rock of this type was found intruded into the Silurian in a sewerage section in South Yarra. Their age is probably Middle Cainozoic. The dykes are injected into the Silurian rocks, but are not found in the Cainozoic sediments.

The dykes, found in the area, are of insufficient magnitude to have any metamorphic effect on the intruded sediments, the only alteration being due to the percolation of solutions, containing iron derived from the dykes, through the sediments causing the deposition of limonite at the contacts, particularly on the foot wall of the dyke.

Exposures of a granitoid rock are found, within the Melbourne District, at South Yarra and Malvern, intrusive into the Silurian sediments. This rock is probably of Lower Devonian age, but has not been found in the Studley Park area.

[1] Langford, W. G., Proc. Roy. Soc. Vic., Vol. xxix. (n.s.), Pt. I., p. 40, 1916.

Cainozoic Sediments.

The Cainozoic sediments are now restricted to isolated patches on the more elevated parts of the area and mainly to the east of the Yarra valley, and in every case they rest unconformably on the eroded Silurian sediments. They are remnants of the old Nillumbik plateau,[2] formed by uplift after the deposition of these sediments. The best locality for the examination of these sediments, within the area described, is in a small gravel pit just south of the road from Johnston-street bridge to Kew, about three-quarters of a mile from the bridge. The rocks consist of ferruginous sands and gravels, with occasional bands of quartz pebbles.

Certain parts of these sands have been bleached by percolating solutions, and the iron has been re-deposited in other layers, forming hard hematitic sands, which resist weathering very well and stand out in good relief from the softer portions of the sediments. Usually the sediments are of an incoherent nature, the only binding being a slight percentage of clayey and ferruginous material.

The current bedding of the sands and the intercalation of pebble bands suggests their deposition along or near a shore line. The gravel consists of water-worn pebbles of milky quartz derived, in all probability, from the quartz veins and reefs that are so common in the crush zones in the Silurian sediments. The pebbles are well rounded and have probably travelled some distance.

Until recently these deposits were regarded as probably of fresh-water origin, but the finding of a cast of a Kalimnan sea urchin defines the age of these deposits as Lower Pliocene[3] and definitely proves them to be of marine origin. The only other fossils recorded from this area are a number of fresh-water sponge spicules, which were probably washed down into them during their deposition.

Since the late Cainozoic uplift these sediments have been very little disturbed, as they are now found lying horizontally on the Silurian. They are not intruded by igneous rocks, but in some areas are found underlying the Newer Basalt.

Newer Basalt.

The Newer Basalt is found filling up the Cainozoic valley, down which the predecessor of the Yarra flowed. The Basalt sheet consists of a series of flows, with a small time interval between each flow.

In the Corporation Quarries, Clifton Hill, about half-a-mile to the north of Studley Park, there are three well-defined flows. The lowest is a dense, medium-grained, finely-textured olivine basalt, containing pale olivine, augite, magnetite, ilmenite, and plagioclase included ophitically in the augite. The top flow is an ophitic olivine dolerite, containing olivine, brown augite, and iron oxide as phenocrysts, with the felspar occurring as lath-shaped crystals enclosed in the augite, and big broad plates of fairly acid plagioclase showing marked zoning. A little interstitial orthoclase is also present in the groundmass.

[2] Jutson, R. T., Proc. Roy. Soc. Vic., Vol. xxiii. (n.s.), Pt. II., p. 469, 1911.
[3] Chapman, F., Vic. Nat., Vol. xxxix., No. 11, p. 158, 1923.

The middle flow is vesicular in nature, and in the cavities and vughs are good crystals of zeolites, especially Phacolite and Phillipsite, and also other secondary minerals, such as Calcite and Aragonite. Underneath the basalt in the quarry are sands of a fluviatile origin, containing occasional fossil tree trunks. The basalt is about 135 feet thick, with a surface elevation of 115 feet. The sands underlying the basalt probably occur in the deepest part of the late Cainozoic valley.

The source of the basalt lies well to the north of the Melbourne district, near Beveridge and Wallan, and the quarries are near the confluence of the two flows of basalt which passed down the valleys of the ancestors of the Darebin and Merri Creeks.

Alluvium.

Alluvial deposits are not very abundant along the valley of the Yarra, and are generally restricted to the inside bank at the bends of the river.

Physiography.

The physiography of the area shows three sharply contrasted types—the Silurian plateau with the Cainozoic cappings, the New Basalt plain, the Yarra valley. The Silurian plateau with its Cainozoic capping is the oldest feature, and belongs, to a considerable extent, to the physiography of pre-Newer Basalt times. The land surface at that period consisted of a fairly broad valley carved out of the old Nillumbik plateau, which stood at the height of about 250 feet above sea-level, having a decided slope to the south. The valley at this time was in a moderately youthful stage, and was occupied by a fairly fast-flowing stream. The remnant of the western side of this valley can be well seen in the sharp rise from the level of the basalt to the top of the Silurian ridge running through Fitzroy and Collingwood. This bank rises about 40 feet in 150 yards, and represents that portion of the valley which was above the level of the basalt, and so was not buried by the Newer Basalt flow coming from the north.

The eastern side of the Yarra valley, although composed entirely of Silurian and Cainozoic sediments, belongs mainly to recent times, as it has been developed by the influence of a relatively young river on a pre-existing valley slope. The slope of the original eastern valley can be traced at the tops of the ridges, and it coincides very nearly in height and cross profile with that of the western slope, but the erosive activity of the present Yarra has produced a sharp drop from the edge of the remnant of the old valley to the present water level. The restriction of the Yarra to the eastern side of the older valley is due to the effect of the Newer Basalt at Fairfield. There it first encounters the basalt, and as the river is flowing nearly west at this locality, the result of the basalt flow coming from the north down the Darebin valley in a southerly direction is to restrict the river's attack to the junction of the basalt and the Silurian on the eastern and southern part of the valley. The Yarra continues to flow along this junction until the mouth is reached.

The centre of this late Cainozoic valley is now filled up by the Newer Basalt which came from the neighbourhood of Beveridge and Wallan, flowing down the ancestors of the Darebin and Merri creeks and uniting near Studley Park. The present floor of the basalt at the Corporation Quarry is about 135 feet below the surface, which has an elevation of about 115 feet above sea-level. The present level of the bottom of the basalt is, therefore, 20 feet below sea-level. As the quarry is about 7 miles from the mouth of the Yarra, the old level of the river bottom was probably about 20 feet above sea-level, so that the present level of the floor of the late Cainozoic valley is about 40 feet below its original level. At South Yarra lacustrine or brackish-water deposits rest on the basalt, and as these deposits are about 20 feet steep, a depression of about 50 feet is indicated. A recent slight uplift has elevated these beds above sea-level, and this uplift is probably contemporaneous with that which resulted in the formation of river terraces on the Moonee Ponds Creek and the shell-bed at Williamstown.[1] The uplift was probably not of the same magnitude as the depression, consequently the floor of the basalt at Clifton Hill is 20 feet below sea-level.

The present valley of the Yarra presents interesting features, as on the western side there is a sharp rise of 25 feet from the level of the river, exposing a narrow strip of Silurian sediments, to the general level of the basalt; thence the surface is fairly level until the western slope of the pre-Newer Basalt valley is reached, where the sharp rise of about 40 feet, previously mentioned, occurs. The eastern slope differs, as there is a precipitous cliff of 80 to 100 feet in height from the water's edge, and then a fairly rapid rise, very similar to that seen in the western slope, before reaching the level of the plateau.

The present junction between the basalt and Silurian on the east suggests that the ancestor of the Yarra possessed rather a meandering course. As the Yarra was forced to flow along this junction, the resulting course is also meanderine. This larger meander has, however, been further eaten into by the present river, resulting in the production of secondary meanders within the larger one. The general trend of the river in the lesser meanders, and also in the large meander in south-easterly and south-westerly directions, may be due to prominent joint planes in the Silurian running in those directions. These directions are approximately in the direction of dip and strike respectively.

The river has confined its course to the Silurian strata, owing to the relative ease with which the river can erode away these rocks as compared with the basalt, and hence there is the tendency for the river to work away from the basalt.

Dight's Falls occur just below the junction of the Merri Creek with the Yarra. In the spur running east and west to the south of the falls, a hard thick sandstone band can be traced to the water's edge dipping upstream. It is due to the relative hardness of this band, compared with that of the adjoining sedi-

[1] Grant, F. E., and Thiele, E. O., Proc. Roy. Soc. Vic., Vol. xv. (n.s.), Pt. I., p. 36, 1902. Pritchard, G. B., Vict. Naturalist, Vol. xxvi., No. 2, p. 20, 1909.

ments, that a hard rock-bar crosses the stream at this point producing the falls. The fall has been accentuated by the construction of an artificial barrier across the river at this point.

Just above Dight's Falls, at the junction of the Merri Creek and the Yarra, there is a good example of a silt jetty produced by the slackening of the velocity of the river and the creek just above the falls, with the consequent dropping of a certain amount of suspended matter to form the silt jetty.

Another interesting recent feature is the development of alluvial flats at the inside bank of the river at the bends. Here the slackening of the velocity of the river causes it to drop part of its load, forming rich alluvial flats. The presence of miniature levees is noticed in several of the flats, particularly in the one at the bottom of Studley Park-road.

GEOLOGICAL MAP OF
STUDLEY PARK AND SURROUNDING AREA.
GEOLOGY FROM QUARTER SHEET, No. 1 N.E.
CONTOURS FROM CONTOUR MAP OF MELBOURNE AND SUBURBS, SHEET 2.
Alluvium
Newer Basalt
Tertiary
Silurian
Scale—2 inches=1 Mile.
0
1 Mile
GEOLOGICAL DEPARTMENT, UNIVERSITY OF MELBOURNE. 1919
CARLTON
FITZROY
COLLINGWOOD
KEW
CLIFTON HILL STATION
VICTORIA PARK STATION
COLLINGWOOD STATION
NORTH RICHMOND STATION
EXHIBITION GROUNDS
YARRA BEND ASYLUM
MELBOURNE
UNIVERSITY
GRATTAN STREET
SYDNEY ROAD
VICTORIA PARADE
HODDLE STREET
WALKER STREET
PARK STREET
GERTRUDE STREET
BRUNSWICK STREET
SMITH STREET
JOHNSTON STREET
NICHOLSON STREET
LITTLE LONSDALE STREET
VICTORIA STREET
ALEXANDRA PARADE
CLARENDON STREET
WELLINGTON STREET
HOTHAM STREET
CREEK
MERRI CREEK
DARLING GARDENS
QUARRIES
CORPORATION QUARRIES
RAILWAY STATION

4. THE GEOLOGY OF MOUNT MACEDON AND WOODEND AREA.

By Associate Professor H. S. Summers, D.Sc.

(*Saturday, 18th August*, 1923.)

Introduction.

Mount Macedon is situated about 40 miles north-west of Melbourne, and is usually visible from elevated portions of the city. The first geological reference to Mt. Macedon is that of Mitchell, the explorer, according to whom the mountain is formed of " syenite so whitened with the weather as to resemble sandstone." The area was first mapped under Selwyn, the southern part by C. d'O. Aplin, and the northern by Norman Taylor. These maps showed granite, basalt, and trap or hypogene, the latter including what are now described as dacite and trachytic rocks. The sedimentary rocks were described on the evidence of the graptolites as Lower Silurian (Ordovician), and certain conglomerates now known as the Kerrie Conglomerate were recorded as a thin capping resting on the Silurian rocks and were referred to the Oolitic Period.

In 1902 Professor Gregory (1)* made a number of contributions to the petrology of the area, and discussed the age and geological relations of the rocks. The granitic rock is described as a granodiorite, intrusive into the Ordovician, and forming part of the " old Palæozoic platform " upon which he regards the Macedon eruptives as having been poured out. The eruptive rocks are described as geburite-dacites, trachy-phonolites, solvsbergites, and andesites, with agglomerates and ashes. These he believed to be of Tertiary age, and to be genetically related to one another.

Hart, Cosmo Newbery, Murray, and Hogg have all contributed to our knowledge of this area.

Physical Features.

The Macedon Range consists of a main ridge running east and west with several well-defined spurs running to the south. The western spur contains the highest point, the Mount Macedon Trig. Station (3,325 feet). The Upper Macedon Spur runs southward from the Camel's Hump (3,295 feet) between the Turritable and Willimigongong creeks, and upon it is situated the township of Upper Macedon. Eastward of the Willimigongong Creek is the Towrong spur, which terminates to the south in Mt. Towrong (2,820 feet). Then follows the Cherokees spur between Baringo Creek on the west and Running Creek on the east. Eastward of the Running Creek the country is extremely rough, and consists of Ordovician sandstones and slates and the Kerrie Conglomerate. The main east and west ridge consists mainly of dacite, but at the eastern end is a low flat-topped hill, Mt. Eliza, a point of eruption for anorthoclase trachyte.

* Numbers in parentheses refer to literature quoted at end.

The northern portion of the area is more open, and consists of a comparatively low-lying peneplain of Ordovician sediments in part covered by trachytic and basaltic lava flows. Among the more noticeable elevations on this plain are the solvsbergite plugs of Hanging Rock and Brock's Monument, the composite cone of the Jim Jim, the lower portion of which is trachyte with a later eruption of andesitic basalt, McAlister's Rock (trachyte), and Melbourne Hill, a thickly timbered hill of Ordovician rocks.

The Main Divide of Victoria crosses the railway line between Macedon and Woodend at an altitude of about 1,900 feet, runs to Mt. Macedon and along the ridge through Camel's Hump to about 2 miles to the east, where it turns north and then north-westerly through the Jim Jim, and thence north to the Cobaw Ranges, where it again turns easterly. As a result of the bend in the Divide streams rising in the neighbourhood of the Camel's Hump and Hanging Rock, such as Deep Creek and Monument Creek, commence flowing north and then swing round and join the Yarra, while Five Mile Creek flows south-westerly, but later turns northward and eventually joins the Murray.

Geological Relations.

Ordovician.

The oldest rocks in the area are sandstones and slates of Ordovician age. Graptolites have been found in several localities, and these show that the Castlemaine and Darriwil horizons of the Lower Ordovician are both present, and that Upper Ordovician beds occur in the south-eastern portion of the area.

The Kerrie Conglomerates were tentatively described (2) as being possibly the basal members of the Upper Ordovician. Later work has been done by Harris and Crawford (4) on the Lower Palæozoic rocks to the south of Macedon. They have come to the conclusion that these conglomerates rest unconformably on the Upper Ordovician and belong to the basal part of the Silurian. Further work is necessary before either view can be definitely accepted.

In the neighbourhood of the granodiorite and also in part at the dacite contact the Ordovician sediments and the Kerrie Conglomerates show distinct signs of contact metamorphism.

The following graptolites have been recorded from allot. 20, parish of Newham: *Didymograptus caduceus*, *Diplograptus palmeus*, *Glossograptus mucronatus*, *Goniograptus* sp., *Lasiograptus* sp., *Phyllograptus typus*, *Tetragraptus quadribrachiatus*. These forms suggest that both Darriwil and Castlemaine horizons are represented.

In allot. 5, parish of Macedon, just south of Upper Macedon, poorly preserved specimens of *Glossograptus* and *Diplograptus* occur, indicating the Darriwil horizon. The following occurrences indicate beds of Upper

Ordovician age:—Allot. 144, parish of Kerrie, *Diplograptus* sp. and *Dicellograptus* cf. *complanatus;* allot. 48A, parish of Kerrie, *Diplograptus foliaceus* and *Dicellograptus elegans.*

Critical areas for the determination of the relationship of the Kerrie Conglomerate to the Ordovician occur in allot. 109, near the mouth of Conglomerate Creek, and allot. 48A, along Emu Creek. Both these areas are in the parish of Kerrie. For discussion of the evidence reference should be made to papers (2) and (4).

The Dacite–Granodiorite Series.

The dacite occupies the central part of the area with three outlying patches on the granodiorite. To the south of Upper Macedon a small area of dacite is separated from the main mass by a flow of trachyte. The main outcrop of the granodiorite lies to the south-east of the dacite, and shows a variation from a normal plutonic rock to granodiorite porphyrite. To the east of Hesket and near Clyde (Braemar House) are small outcrops of granodiorite, and in 1922 another small outcrop was located on Mrs. McGregor's property near the road between Clyde and the Camel's Hump.

Gregory (1) stated that the dacites were probably Tertiary in age and were piled up on a peneplain of Ordovician and granitic rocks. Later work (2) has shown that the dacite shows distinct contact metamorphism along its junction with the granodiorite, and is clearly the older rock. The dacite and granodiorite though differing somewhat mineralogically show great similarity in chemical composition, and it has been inferred in consequence that they are derived from a common magma. The precise age of this series is indeterminate in the Macedon district, but, by comparison with other areas in which similar rocks occur, there is little doubt that the dacite was extruded in the Lower Devonian period, and that its extrusion was closely followed by the intrusion of the granodiorite.

It can be seen from the map and from sections published elsewhere (2 and 6) that the dacite rests on the granodiorite over a considerable area. The platform on which the dacite rested must have been composed of Ordovician sediments. The sediments underlying the dacite have subsequently been largely replaced by the granodiorite. Such replacement may have taken place in one of the three following ways:—

1. The granodiorite may have been intruded along the junction of the dacite and Ordovician.
2. The Ordovician sediments may have been removed by assimilation.
3. The Ordovician sediments may have been removed by overhead stoping.

The last alternative seems to accord best with the observed facts.

It is believed that the magma before the extrusion of the volcanic phase had stoped its way sufficiently near to the surface for partial collapse of the roof of the batholithic chamber, or alternatively for the production of fissures

connecting the batholithic chamber with the surface. In either case escape to the surface of the upper portion of the magma could take place. The escaping lava must have been fairly viscous as the dacite was piled up in a dome-shaped mass. Solidification of the dacite sealed up the vents from the batholithic chamber and conditions became favorable for the resumption of stoping, with the result that the palæozoic platform was entirely removed from a considerable area, thereby bringing the granodiorite in direct contact with the dacite.

The typical dacite consists of phenocrysts of labradorite and hypersthene, with smaller and less numerous phenocrysts of ilmenite and biotite set in a granulitic groundmass consisting of quartz, orthoclase, plagioclase, biotite, and ilmenite. The phenocrysts of labradorite and hypersthene, especially the latter, generally show corrosion. Biotite frequently occurs in aggregates bordering the hypersthene.

The granodiorites consist of quartz, labradorite, with outer zone of andesine, orthoclase, and biotite. It will be seen that the principal mineralogical difference is the presence of hypersthene in the dacite and its absence from the granodiorite.

In most cases the groundmass of the dacites is holocrystalline, but at Cheniston and Hesket are found types with either a glassy or extremely fine-grained groundmass. These types occur near the outer margin of the base of the dacite dome and are practically in contact with the Ordovician sediments, and so may be taken to represent portion of the original chilled margin. These types show the ordinary phenocrysts of hypersthene and plagioclase, but are practically free from biotite. From this it is inferred that the phenocrysts of hypersthene and labradorite had formed prior to the extrusion of the dacite, and that the temperature of the magma was generally rather above the reaction temperature between hypersthene and alkali felspar, by which biotite would be formed and free quartz liberated.

At the time of the extrusion, the magma probably contained a certain proportion of water and other volatile constituents, and some of these gases escaped when the lava reached the surface. This loss of water, &c., and the expansion of the lava due to loss of pressure, served to convert a magma sufficiently fluid to be able to stope its way upwards, into a moderately viscous lava, incapable of extensive flow from the vent. Solidification at the border under these conditions probably was rapid, and no further reaction between the hypersthene and felspar molecules could take place. Inward from the margin cooling was slower and the temperature of final consolidation was lower, owing to partial retention of the volatile constituents. In consequence of this biotite was formed at the expense of hypersthene and alkali felspar, and free quartz was liberated.

It may be noted here that the progressive signs of contact metamorphism in the dacite near the granodiorite contact are the production of more and more biotite, until near the junction of the two rocks hypersthene is completely replaced by a mixture of biotite and quartz.

The relation of the granodiorite and dacite in respect of chemical composition is readily explicable on Bowen's theory of differentiation. Owing to the sinking of early formed basic crystals the magma, prior to the extrusion of the dacite, would show increasing acidity upwards. In the case under consideration the upper more acid portion reached the surface forming the dacite dome. On the sealing up of the batholithic chamber as postulated earlier, the upper portion of the magma left in the chamber would be less acid than that which had reached the surface. Further crystallization and sinking of crystals would go on, and the new upper layer would constantly gain in acidity. According to the length of time between the extrusion and the final solidification of the magma so would the relative silica percentage of the volcanic and plutonic phases differ. In this case the time interval was sufficient for the plutonic phase to show in general a distinctly higher silica percentage than the dacite (6). Owing to the slow cooling of the plutonic mass and the low temperature of final consolidation the first formed hypersthene has been completely resorbed and replaced by biotite. An interesting rock type is found near Hesket. In the dying stages of igneous activity portion of the dacite has been acted on by escaping mineralizers, with the result that the original hypersthene has been converted to biotite and then largely chloritized and the groundmass has re-crystallized, giving a micrographic intergrowth of quartz and felspar. Secondary sulphides were also introduced. The resulting rock, described as propylitized dacite, shows in the hand-specimen apparent coarseness of grain characteristic of a plutonic rather than a volcanic rock. Microscopic examination, however, indicates its true character.

Critical Areas.—The dacite and granodiorite come into close contact near Braemar House (Clyde) and McGregor's, but the relationship is obscured by hill slipping. The best areas for studying the relations are along the junction just east of Barringo Creek, in allotments 165, 166, 167, parish of Kerrie, and near the Kerrie School House, in allotments 187, 189, and 56A, in the same parish. In allotment 187 small aplite veins have been found traversing the dacite near its junction with the granodiorite.

The Tertiary Volcanic Series.—The Tertiary volcanic series includes solvsbergites, anorthoclase trachytes, anorthoclase basalts, basalts, limburgites, and two new rock types, macedonite and woodendite.

The solvsbergites occur at the Camel's Hump, Hanging Rock, and Brock's Monument. All three show phenocrysts of either anorthoclase or soda sanidine in a finer-grained groundmass. Ægirine is present in all types; blue riebeckite occurs abundantly in specimens from the south-eastern flank of the Camel's Hump, and sparingly at the Hanging Rock. Cossyrite is fairly common at

Brock's Monument. These masses of solvsbergite may represent worn-down necks of volcanoes or may be in the form of mamelons. Brock's Monument appears to belong to the latter type.

The anorthoclase trachytes contain phenocrysts of anorthoclase in a trachytic to orthophyric groundmass of felspar and ægirine. Olivine is absent in the more acid varieties, but iddingsite after olivine is fairly common in the Sugarloaf type. On the flanks of the Cobaw Range a still more basic form occurs with olivine and ægirine-augite and augite. The trachytic lava was generally fluid and gave rise to widespread flows.

The anorthoclase basalts show corroded phenocrysts of anorthoclase. The proportion of these phenocrysts varies, and as the amount diminishes we pass to normal basalts.

The limburgites consist of phenocrysts of augite and olivine, frequently altered to iddingsite, in a more or less altered brown glass containing minute crystals of augite, ilmenite, felspar, &c. Analcite has also been recorded.

The macedonite and woodendite are forms somewhat related to the orthoclase basalts described by Iddings under the names shoshonite and absarokite. The macedonite occurs in the eastern part of the area, and the woodendite at Old Race-course Hill, just north of Woodend.

The order of eruption is in many cases difficult to establish, but may be as follows :—

1. Anorthoclase trachyte.
2. Solvsbergite.
3. Macedonite, woodendite, and anorthoclase basalt.
4. Basic trachyte.
5. Limburgite.
6. Basalt and andesitic basalt.

It has been shown (2) that the analyses of some of these types conform well to the graphs in a variation diagram and that others diverge widely from the graphs. In the case of these latter, however, their mean composition, determined by multiplying the analysis of each type by its area of exposure and reducing the result to percentages, conforms extremely well with the graphs. It has been suggested that the differentiation of the first set may be termed serial differentiation and of the second complementary differentiation.

We may postulate differentiation by crystallization with concurrent sinking of crystals as the process by which the serial differentiation took place, but some other explanation is necessary to account for the complementary forms. The mean composition of the alkali rocks has been determined (2), and it has been shown that if the anorthoclase trachytes and solvsbergites were extruded, the remaining magma would have approximately the same composition as a blend of the remaining members of the serial group, *i.e.*, the Sugarloaf trachyte, the basic trachyte to the south of eth Cobaw Range, and

the limburgites, and also as a blend of the complementary types, *i.e.*, macedonite, woodendite, and anorthoclase basalt. It is suggested that possibly the magma after the extrusion of the anorthoclase trachyte and solvsbergite was separated into two magma basins, the composition of the two parts being similar. In one of these parts serial differentiation by crystallization and sinking of crystals continued, whereas in the other part conditions were altered by earth movements. Crystallization may have been proceeding for some time when earth movements caused portion of the liquid to be squeezed away from the remainder, thus producing two fractions differing considerably in composition but complementary to one another. If such squeezing out of liquid took place twice with a marked interval between, this might account for the three complementary types that have been recognised. It is realized that this hypothesis is not very convincing, and it is only advanced tentatively.

In allotment 15, parish of Newham, a rather interesting agglomerate occurs (5). Some of the fragments are quartz-bearing pieces of the Ordovician sediments, others are fragments of an alkali igneous rock with abundant well-shaped but minute sections of nepheline, indicating the existence of nepheline phonolite in this area.

Critical Areas.—(*a*) *Relation of the Alkali Rocks to the Older Series.*—Upper Macedon is built mainly on a trachyte flow. The point of eruption is One Tree Hill or Baillieu's Hill, and the flow filled up an old stream course. Two streams then formed along the junction of the trachyte and dacite, that to the east being known as Willimigongong Creek, and that to the west the Turritable Creek. This latter creek crosses the trachyte flow near the southern end, and by means of headward erosion has cut a gorge-like valley. The gorge upstream terminates in the Turritable Falls, above which very little dissection has taken place.

North-west of Clyde a flow of trachyte occupies an open valley in the dacite and spreads out over the adjoining Ordovician. The Mount Macedon Village Settlement is situated on trachyte, which broke through the dacite and flowed northward to spread out on the plains.

The solvsbergite of the Camel's Hump forms a plug through the dacite. The Mount Eliza trachyte flow rests on the granodiorite. There are numerous vents of trachytic and basaltic lavas on the Ordovician plains to the north of the main ridge.

(*b*) *Relations of the Tertiary Volcanic Rocks to one another.*—*Solvsbergite and Anorthoclase Trachyte.*—To the south-east of the Camel's Hump is a flow of trachyte not recorded in paper No. (2). This occurs at the base of the Hump, and is best explained as a small flow of trachyte from the vent subsequently filled by the solvsbergite plug.

The Hanging Rock solvsbergite is completely surrounded by trachyte, and the relative age is rather indeterminate. It is conceivable that the solvsbergite was formed and later was completely surrounded by trachyte: but it seems

more reasonable to assume that the flows of trachyte covered the whole areas, and that the solvsbergite was of later date. No inclusions of trachyte in the solvsbergite have so far been noted.

Anorthoclase Trachyte and Anorthoclase Basalt.—In allotments 80, 83, and 92, parish of Woodend, to the north-east of Woodend, the anorthoclase basalt clearly overlies the anorthoclase trachyte. The edge of the flow of basalt forms a well-defined ridge and the trachyte outcrops along its base.

Anorthoclase Basalt and Sugarloaf Trachyte.—The Sugarloaf trachyte occurs to the north-east of Macedon in allotments 84 and 85, parish of Woodend, and allotments 9, 10, 11, &c., parish of Newham. At the base of the Sugarloaf Hill, at both the eastern and western sides, are small quarries in the anorthoclase basalt. Immediately overlying this basalt is the trachyte (Sugarloaf type).

The Alkali Rocks and the Basalt.—The Jim Jim consists of an older flat-topped hill of anorthoclase trachyte through which a later andesitic basalt has broken. This andesitic basalt formed a cone on the trachyte platform, and the lava flowed southwards and appears to overlie portions of the anorthoclase basalt and the Sugarloaf trachyte. The field evidence of the relations of the other types is obscure, and the suggested order of extrusion is based on hypothetical grounds discussed earlier.

Buckshot Gravels.

These consist of rounded pellets of limonite which occur as a superficial deposit. They are in part the result of alteration of the Tertiary volcanic rocks, especially in ill-drained areas. Sections are poor, and the relationship to the underlying rocks is generally obscure.

Tertiary Gravels.

In several areas, notably near Woodend, patches of gravel occur, sometimes partially overlain by volcanic rocks, in which case the gravels are often converted to pebbly quartzites. They probably mark the position of old stream courses, but owing to their scattered nature the location of these pre-volcanic streams has not been determined.

Near Five Mile Creek, in allotments 2 and 3, parish of Newham, these gravels are seen to underlie the anorthoclase trachyte, so that this patch at least is older than the earliest of the Tertiary eruptions of the area.

Alluvium.

This occurs mainly along stream courses, but the large area to the south-east of Upper Macedon has been formed by the damming back of the streams by basalt near Robertson's Hill.

Chemical Analyses of Macedon Rocks.

The following table gives analyses of typical rocks of this area. Only the principal constituents are shown :—

	I.	II.	III.	IV.	V.	VI.
SiO_2	62·54	64·04	66·86	59·52	54·06	43·82
Al_2O_3	16·66	15·58	16·34	18·06	17·13	12·90
Fe_2O_3	1·04	0·80	2·38	3·76	6·10	6·74
FeO	5·54	4·47	1·99	2·27	3·55	6·25
MgO	2·68	2·64	0·22	0·78	3·05	9·32
CaO	3·92	3·52	0·92	1·98	4·88	9·44
Na_2O	2·66	2·42	6·01	5·38	3·97	2·49
K_2O	2·47	2·80	4·07	5·03	3·29	1·75
H_2O	0·63	2·63	0·59	1·84	1·80	2·96
TiO_2	1·20	0·80	0·21	0·67	1·95	3·50
P_2O_5	0·20	0·18	tr.	0·27	0·74	1·02
MnO, &c.	..	..	..	..	0·23	0·37
Total	99·54	99·88	99·59	99·56	100·75	100·56

I. Dacite, Braemar House (Clyde).
II. Granodiorite, Braemar House (Clyde).
III. Solvsbergite, Brock's Monument.
IV. Anorthoclase Trachyte, Turritable Falls.
V. Anorthoclase Olivine Trachyte or Sugarloaf Trachyte.
VI. Limburgite, Upper portion of King's Quarry.

Outline of Sequence of Events in the Geological History of the Macedon District.

1. Lower Ordovician sandstones and slates deposited.

2. Uplift of Lower Ordovician and folding along axes which ran approximately north and south. Denudation.

3. Subsidence and deposition of the Upper Ordovician unconformably on the Lower Ordovician. The Kerrie conglomerate forming the basal conglomerate of the Upper Ordovician. (This last statement must be revised if Harris and Crawford's (4) conclusions be correct.)

4. Uplift and further intense folding along axes running approximately north and south. This gave rise to the shearing and dimpling of pebbles in the conglomerate. Denudation.

5. Subsidence and deposition to the east of Silurian sandstone and shales. These contain occasional dimpled or sheared pebbles probably derived from the folded and denuded Kerrie conglomerate. (See reference 2, p. 42.)

6. Uplift and further folding along north and south axes. Extrusion of the dacite followed by intrusion of the granodiorite. The folding and associated igneous activity probably took place in the Lower Devonian period.

7. Hiatus in the history till the Tertiary period. The Lower Palæozoic sediments had been largely peneplained and the dacite dome stood up as a monadnock.

8. Outpouring of the Tertiary trachytes, &c., altering the drainage of the area and creating in parts a low immature divide.

9. Denudation modifying the surface and giving rise to deposits of alluvium.

Literature.

The more important recent papers having reference to Macedon are listed below. For earlier references see papers (1) and (2)—

(1) Gregory, J. W., Proc. Roy. Soc. Vic., Vol. 14 (n.s.), Pt. II., p. 185, 1902.

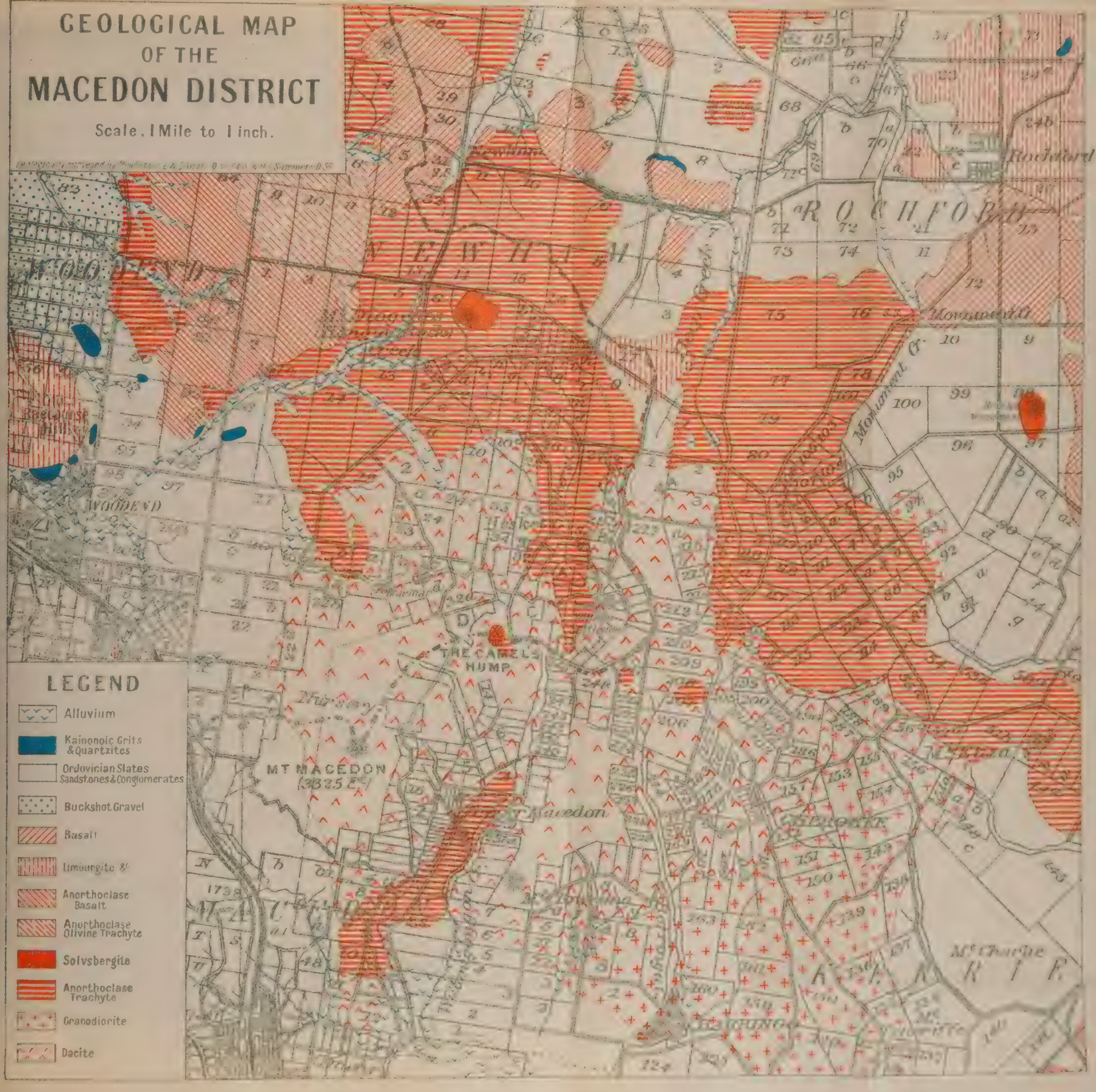
(2) Skeats, E. W., and Summers, H. S., Bull. Geol. Surv. of Vict., No. 24, 1912.

(3) Summers, H. S., Proc. Roy. Soc. Vic., Vol. 26 (n.s.), p. 256, 1914.

(4) Harris, W. J., and Crawford, W., Proc. Roy. Soc. Vic., Vol. 33 (n.s.), p. 39, 1921.

(5) Skeats, E. W., Report of the Alkaline Committee, A.A.A.S., Hobart-Melbourne Meeting, 1921.

(6) Summers, H. S., Proc. Roy. Soc. Vic., Vol. 35 (n.s.), p. 134, 1923.


GEOLOGICAL MAP
OF THE
MACEDON DISTRICT
Scale. 1 Mile to 1 inch.
LEGEND
Alluvium
Kainonoic Grits & Quartzites
Ordovician Slates Sandstones & Conglomerates
Buckshot Gravel
Basalt
Limburgite &
Anorthoclase Basalt
Anorthoclase Olivine Trachyte
Solvsbergite
Anorthoclase Trachyte
Granodiorite
Dacite
THE CAMEL'S HUMP
MT MACEDON
(3832 ft)
Macedon
Rochford
Monument Cr.
Beetlerose Hill
WOODEND
Mt Barry
Mt Charlie
R O C H F O R D

5. EXCURSION TO LANCEFIELD AND MONEGEETA.

(*Sunday, 19th August*, 1923.)

On the Cambrian (Heathcotian) and Lower Ordovician Rocks of the Lancefield and Romsey Districts.

By Professor Ernest W. Skeats, D.Sc., A.R.C.S., F.G.S.

Introduction.

No connected geological account of the area included in the above districts has hitherto been given. The early Geological survey mapped the area excepting that part including Mount William and for two miles south from it, and their results were published in Quarter-sheets Nos. 5 S.E. by Norman Taylor and 6 N.E. by C. D. H. Aplin. In the Reports and Papers relative to the mining and Geological Survey of Victoria 1863, Norman Taylor contributed notes explanatory of the geology of the district comprised in quarter-sheets 5 S.E. and S.W. and 6 N.E. and N.W., pp. 6–9. The boundaries of the Newer Basalt and recent rocks are correctly shown on the maps, but the author has found it necessary to introduce important corrections in the boundaries of the older rocks, especially in the relations between the Silurian and the older rocks of the area, and has been able to suggest an approximate mapping of subdivisions in the Lower Ordovician and Cambrian rocks (see maps). Rocks of Cambrian age were not recognised by the Survey and the area in which they occur was shown partly as Silurian and partly as Ordovician (Lower Silurian of the Survey). Brief reference to the relations of the older rocks of the area has been made by the author and others.[1]

Physical Geography.

The older rocks of the area from Mount William in the north to Brock's Hill in the south form a ridge whose general trend varies from N. 25° W. in the northern part to approximately N. and S. in the southern part of the area. The town of Lancefield, 1,559 feet above sea-level, and 46 miles by railway northerly from Melbourne, and about 3 miles west of the ridge, provides access to the northern part of the area, while Romsey, 1,597 feet above sea-level, and 40½ miles by railway northerly from Melbourne, and North Monegeeta, 1,495 feet above sea-level, each about 3 miles west of the ridge of the old rocks, are the nearest stations in the southern part of the area.

This ridge consists of the resistant rocks, diabases and cherts, of the Cambrian (Heathcotian) series. Within the area under consideration the height of the ridge is generally, apart from Brock's Hill, low in the southern part of the area and steadily rises in a northerly direction, reaching its culmination at Mount William at a height of 2,689 feet. Its continuity is broken in the central part of the area by a gap or saddle 1,830 feet above sea-level, known as the Kilmore Gap, which carries the road connecting Lancefield and Kilmore and the unused

[1] E. W. Skeats. Pres. add. to Sect. C. Aust. Assoc. for Adv. of Sc., Brisbane, 1909, pp. 174 and 180.
T. S. Hall. Vic. Nat. Vol. XXV., May, 1908, pp. 9–11.
J. W. Gregory. Proc. Royal Soc. Vic., N.S., Vol. XV., Pt. II., 1903, pp. 165, 167, and 168.

railway line between these towns. In a northerly direction the ridge is abruptly cut off about half-a-mile north of Mount William, for a later intrusive granodiorite mass, which forms the easterly part of the Cobaw Ranges and stretches northwards to Pyalong, is exposed at the surface and forms relatively low-lying country. North of Pyalong, at Tooboorac, the old Heathcotian rocks again outcrop, but as they consist of weathered diabase ash for the most part, do not form a surface feature till north of Heathcote. Their northern outcrop beyond Heathcote extends as a prominent ridge of diabase and cherts through Mount Camel to Colbinabbin and constitutes the Colbinabbin range, which has a general north and south trend.

The Lower Ordovician sediments lying to the west of the Lancefield-Romsey ridge have weathered to a relatively low-lying area, much of which is concealed by flows of Newer Basalt, while to the east of the ridge the outcrop of the Silurian rocks consists of wooded undulating hills. The junction between the Heathcotian and Silurian is, however, masked over most of the area described in this paper by a basalt flow which, starting from a centre about 3 miles S.S.E. of Mount William, flowed in a general southerly direction. Evidently in the pre-New Basaltic (late Cainozoic) period the uncomformable junction of the Heathcotian and Silurian rocks constituted a line of weakness along which a valley had been developed.

The relative abruptness of the old Heathcotian ridge and its linear trend might suggest that it was produced by recent faulting. This view is, however, disproved by the evidence of the fine sections exposed in the railway cuttings on the Kilmore railway line running N.W. from the Kilmore Gap and cutting obliquely across the Heathcotian and Lower Ordovician rocks. Apart from one minor fault, probably within the Heathcotian series, there is continuity of sedimentation and parallelism of strike between the Heathcotian and Lancefieldian sediments, and, in fact, the junction between them can only be approximately determined on the scanty available fossil content. There can be no doubt that the linear direction of the ridge conforms generally to the strike of the rocks and that the ridge has been produced by differential erosion.

The drainage of the area is carried by streams consisting of tributaries of the Saltwater River. To the west of the Heathcotian ridge occurs one tributary of the Saltwater River described on the Geological Quarter-sheet and on the Parish Plans as the Saltwater River or Deep Creek. It flows mainly near the junction of the Newer Basalt, and in places exposes sections of the Lancefieldian and Heathcotian rocks. One tributary known as Five Mile Creek starts near Romsey and joins Deep Creek N.E. of Hurst's Hill. To the east of the ridge a stream starts from near the centre of eruption of the narrow basalt flow, which conceals the boundary of the Heathcotian and Silurian series and flowing south and west within the area cuts through the basalt and exposes good sections of the Silurian rocks especially in the southern part of the area. It is named No. 3 Creek on the Geological Quarter-sheet and Boyd's Creek on the Geological Map of Victoria (16 miles to 1 inch). It joins the Deep Creek west of Wallan and the two then constitute the Saltwater River.

The Heathcotian (Cambrian) Series.

As in the Heathcote, Howqua, Dookie, and Mount Stavely areas, the rocks of this series consist of basic lavas (diabases) and basic ashes and of interbedded marine fine-grained sediments much of which now consist of very hard cherts and some of which comprise less silicified shales. The cherts are bleached at the surface by weathering, and in places converted into rotten stones by surface desilicification.

The basic lavas (diabases) are prominent at Mount William and at intervals going south, as for instance in the railway cutting in the Kilmore Gap, where at least four lava flows are interbedded with the cherts, and a good section also is exposed by the Deep Creek in the southern part of the area to the west of Hurst's Hill and north of Brock's Hill. The lavas in places show well-developed spheroidal jointing, the spheroids sometimes being flattened and suggesting an approach to pillow structure. This feature can be noticed in the railway cutting at the Kilmore Gap and also on the west flank of Hurst's Hill.

Three traverses across the Heathcotian outcrops in a west to east direction will serve to illustrate the sequence.

1. Traverse from ½-mile S.E. of bridge over Deep Creek along the road to Kilmore Gap and including the railway section, length about 1 mile. Half-a-mile from the bridge outcrops on the road commence with cherty shales and chocolate fragmental mudstones resembling lithologically the Dinesus beds of Heathcote, and like them occurring just west of and conformably above the diabase. These shales and mudstones continue nearly to the Kilmore Gap. *Protospongia* and *Acrotreta* have been found in these, the latter 300 yards west of the gap. The beds strike N. 35° W. and dip where first seen easterly at 60–70°. Further east steeper easterly dips continue for ⅓ mile, then high westerly dips at 80–85° for 300 yards, then easterly again at the west end of the railway cutting, then vertical and high westerly dips at the east end of the railway cutting. These may be acute folds or the limb of one big fold nearly vertical with slight reversals of dip. In the railway cutting starting from the west end the sequence is bedded cherts and cherty shales for about 250 feet, platy and spheroidal diabase for 250 feet, black dense cherts for 30 feet, small spheroidal diabase 60 feet, cherts 40 feet, platy diabase 110 feet, diabase with large spheriods approaching pillow structure 65 feet, diabase with small spheroids 145 feet, cherts 15 feet, diabase 240 feet, and at the east end cherts and cherty shales 30 feet.

Protospongia has been found in several of the chert beds, occasionally as solid spicules and abundantly as casts in partially desilicified cherts (rotten stones) at the east end of the railway cutting.

2. Traverse easterly from Drover's and Carrier's Arms 1½ miles north of Romsey to the Silurian of No. 3 Creek. The traverse starts in newer Basalt and continues easterly for about 2½ miles to Deep Creek. The Creek section shows cherts, cherty shales, and black mudstones with alternately high westerly and

high easterly dips. Further east on the road the rocks are shown on the Quarter-sheet as Silurian, but they are really Heathcotian cherts and cherty shales up to the junction with the Basalt, which conceals the Heathcotian Silurian junction. The Silurian does not outcrop for 1½ miles in an E.N.E. direction in the section exposed by No. 3 Creek.

3. Traverse from west of Hurst's Hill, round the Hill and thence N.E. to the Silurian outcrop. The traverse starts in Newer Basalt. On descending to Deep Creek, which flows to the west, south, and south-east of Hurst's Hill, cherts, silicified diabase tuffs, and cherty shales are first seen striking N. 10°–20° E. and dipping easterly at 75°–80°. This dip is probably due to overfolding, as the older rocks lie to the east. With these rocks occur black shales with fossils, including *Archæocryptolaria*, &c. These black shales junction sharply with cherty diabase and are followed by massive spheroidal diabase. Further south-east, in the creek section, cherts and diabases are interbedded, and further east a big acid dyke is noticed followed by cherts in the creek. North-east of Hurst's Hill comes Newer Basalt, then an inlier of cherty shales and after more Newer Basalt the traverse descends again to Deep Creek and exposes Silurian mudstones, sandstones, and coarse grits pebbles of Heathcotian cherts.

Microscopic characters of the Heathcotian Rocks.

The cherts are dense, fine-grained rocks with occasional minute quartz veins and minute micaceous flakes in a silicious matrix. Sections of *Protospongia* are seen in some of them, and roughly circular chalcedonic areas which may be altered *Radiolaria*. Some of the cherts contain fragments suggestive of igneous material, and are probably diabase ashes replaced by secondary silicification. Some of the diabases are minutely fragmental altered ashes. Among the massive types those from Mount William and its neighbourhood are for the most part altered to more or less platy or somewhat foliated rocks. This is due to the development of secondary fibrous and actinolite replacing the original augite of the rock. In some of the sections the replacement has been partial, in others complete. Some of the original plagioclase remains as cloudy crystals, but a good deal has been re-crystallized to clear secondary crystals. Albite has not been recognised with certainty in any of these diabases. It, however, has been described from the Heathcotian diabases of the Howqua district,[1] some of which definitely belong to the spilitic suite. It is probable that further study will also demonstrate this in the cases of the diabase from Heathcote and Lancefield. The more massive and spheroidal diabase from the Kilmore Gap road and railway cuttings, and from Hurst's Hill in the southern part of the area, is much less altered. A certain amount of chlorite is present, and some of the plagioclase is cloudy, but the original pale augite with granular habit remains. Many of the felspars are clear and zoned and consist of acid labradorite, and a little quartz, apparently secondary, fills interstices and is surrounded with alteration products. Ilmenite, more or less altered to leucoxene, is always present, and many of the sections and hand

[1] E. O. Teale, Proc. Royal Soc. Vic., Vol. XXXII. (N.S.), Pt. I., 1919, pp. 33–36.

specimens of the diabase contain a fair amount of pyrite. The somewhat platy type of diabase from Mount William due to the development of secondary actinolite may be produced as a metamorphic effect of the granodiorite intrusion of the Cobaw to Pyalong massif. This intrusion has developed spotted and chiastolite rocks in the Lower Ordovician slates to the west of Mount William for a distance of nearly a mile from the contact. The selection by the aborigines of two sites for quarries for making aboriginal implements, in McLennan's paddock and in J. Dunlop's paddock just north of Mount William, may be attributed to the special toughness imparted to the rock by the considerable development of fibrous actinolite.

Fossils from the Heathcotian Series of the Lancefield–Romsey Districts.

No trilobites such as *Dinesus* which have been recorded from Heathcote have been found in this area, although, as mentioned above, some of the fragmental chocolate cherty mudstones west of Kilmore Gap have considerable lithological resemblance to the Dinesus beds of the Heathcote district. The forms hitherto described from the Heathcotian of this district are mentioned below, and are included in the following papers :—

1. Chapman, F.—Proc. Roy. Soc. Vict., Vol. XXX. (n.s.), Pt. II., 1918, pp. 145, 148., pl. xxvi.
2. Chapman, F.—Proc. Roy. Soc. Vict., Vol. XXXI. (n.s.), Pt. II., 1919, pp. 388–393, pls. xix. and xx.
3. Chapman, F., and Skeats, E. W.—Geo. Mag. N.S., Dec. VI., Vol. VI., No. 666, Dec. 1919, p. 550, pl. xv.

Faunal Lists.

1. Two miles E.N.E. of North Monegeeta. In the bed of Deep Creek in unaltered black shales in contact with diabase.

Archæolafoëa longicornis Chapman.
Mastigograptus monegettæ Chapman.
Archæocryptolaria skeatsi Chapman.
Archæocryptolaria recta Chapman.
Acrotreta antipodum Chapman.
Caudal spine of phyllocarid, cf. *Hymenocaris.*

2. Road-metal heap on road ½ mile S.E. of Mount William Railway Station—
Acrotreta antipodum Chapman.
cf. *Protospongia.*
cf. *Hymenocaris.*

LOWER ORDOVICIAN ROCKS.

Lancefield Series.

The Lancefield series lies to the west of the Heathcotian outcrops. The only locality from which published records of the occurrence of fossils of this series have been given is a small quarry in allotment 56, parish of Goldie, about half-a-mile north of Mount William Railway Station. The rocks in the quarry are fine bedded black shales, cherty shales, and cherts dipping westerly at

80°–85° and striking N. 20° W. The writer has found four additional fossil localities in this series. From north to south they are as follows :—

1. About 4½ miles northerly from Lancefield on the road to Mount William, at a bend in the road just beyond Mount William State School. There black cherty shales and shales much altered by contact metamorphism are striking about N. 30° W., and have a high dip. They have yielded the following forms :—*Bryograptus*, *Clonograptus*, *rigidus* var. *tenellus*, *Didymograptus*, and *Protospongia*.

2. At the northerly bend in the road running east and west at the S.E. corner of allotment 44, parish of Goldie, and about ¾ mile northerly from Lancefield graptolite quarry. Traces of graptolites and crustacea of the *Rhinopterocaris* type occur in cherty shales.

3. About 300 yards west of Mount William Railway Station in the railway cutting, in pale cherty shales dipping westerly at a high angle and striking N. 20°–25° W. These have yielded *Clonograptus rigidus* var. *tenellus* and *Tetragraptus* sp.

4. About 250 yards south of the bridge over Deep Creek and E.S.E. of Lancefield, chocolate-coloured, micaceous, sandy mudstones, dipping westerly at 80° and striking N. 30° W., have yielded fragments of *Bryograptus* and traces of sponge spicules.

These additional fossil localities enable an approximate boundary for the Lancefield series to be traced on the map. The beds show parallelism of strike and general conformity of high dips with the Heathcotian series to the east. There can be no doubt that they rest conformably on the Heathcotian series, but no exact boundary between them can be drawn, since fossil localities are few and lithological resemblances between the two series are considerable. Cherts, cherty shales, and cherty mudstones occur in both series, but in the Lancefield series shales and mudstones predominate, while in the Heathcotian series cherts form the common rock type apart from the basic lavas and ashes. Fossils from the Lancefield series have been described in the following publications :—

Pritchard, G. B. (*a*) *Proc. Roy. Soc. Vict.*, Vol. IV. (N.S.), Pt. I.,. 1892, pp. 56–58.

(*b*) *Ibid.* Vol. VII. (N.S.), 1895, pp 27–30.

Hall, T. S. (*a*) *Proc. Roy. Soc. Vict.*, Vol. IV. (N.S.), Pt. I. 1892, pp. 7–8.

(*b*) *Ibid.* Vol. X. (N.S.), Pt. I. 1897, pp. 13–16.

(*c*) *Ibid.* Vol. XI. (N.S.), Pt. II., 1899, pp. 152–155

(*d*) *Ibid.* Vol. XI. (N.S.), Pt. II., 1899, pp. 164–178.

(*e*) *Geol. Mag.*, Dec. IV., Vol VI., 1899, pp. 439–451.

Keble, R. A. .. *Rec. Geol. Surv., Vict.*, Vol. IV., Pt. II., 1920, pp. 195–202.

Faunal Lists.

The locality is a quarry, allotment 56, parish of Goldie

Protospongia oblonga T. S. Hall.
Dictyonema macgillivrayi T. S. Hall.
Dictytonema pulchellum T. S. Hall.
Bryograptus victoriae T. S. Hall.
Bryograptus clarki T. S. Hall.
Leptograptus antiquus T. S. Hall.
Didymograptus pritchardi T. S. Hall.
Didymograptus taylori T. S. Hall.
Tetragraptus decipiens T. S. Hall.
Clonograptus flexilis J. Hall sp.
Clonograptus rigidus J. Hall sp.
Clonograptus rigidus var. *tenellus* Linnarsson.
Clonograptus magnificus Pritchard sp.
Phyllograptus (?) sp.
Rhinopterocaris aff. *maccoyi*. Eth. fil. sp.
recorded by T. S. Hall as *Lingulocaris*, allied to, if not identical with, *L. maccoyi* Eth. fil.)

Bendigo Series.

Graptolites characteristic of the Bendigo series have been recorded by McCoy from the Lancefield district, and consist of specimens collected over 60 years ago by the Geological Survey. The localities, referred to by letters and numbers, are apparently outside the area of the Quarter Sheet 5 S.E., since they are not recorded on the map. Within the area shown on the maps accompanying this paper rocks of the Bendigo series outcrop only to the north of Lancefield. Their southerly extension is masked by the fairly widespread lavas of the Newer Basalt period. The only locality where the author has found fossils is on the road to Mount William, about 3½ miles north of Lancefield, on the northern boundary of allotment 49, parish of Goldie. A road cutting here consists of micaceous sandstones and black and blue cherty shales dipping westerly at 80° and striking N. 30° W. They have yielded specimens of *Tetragraptus fruticosus*, both the three-armed and four-armed varieties, *Goniograptus macer*, *Phyllograptus*, and *Rhinopterocaris*. Somewhere between this outcrop and that on the road near the Mount William State School lies the junction between the Bendigo and the Lancefield series It cannot be defined precisely for lack of exposures and fossil records, but since both dip and strike of the two series in the two localities closely agree, there can be no doubt that the Bendigo series overlies conformably the Lancefield series.

The Silurian Rocks.

As was indicated in the introduction, the limits of the Silurian rocks are incorrectly shown on the Geological Quarter Sheet. On the eastern slopes of the Mount William range and down to the southern limit of Quarter Sheet

S.E. the rocks coloured as Silurian are typical Hoathian slates and phases. The boundary between the Hoathian and Silurian in the area is everywhere concealed beneath flows of Newer Basalt. East of the basalt flow the Silurian rocks are lithologically distinct from the Hoathian series. A good section is seen in a railway cutting near where the line crosses the Kilmore road about 2 miles east of the Kilmore Gap. Here shales and sandstones, with dimpled and sinuous pebbles of quartzite as well as pebbles of quartz and of slates of the Hoathian type, occur. The strike of N. 30° W. and the easterly dip of 80° are in contrast with those of the adjoining Hoathian rocks. About 2 miles S.E. of this railway cutting, in a quarry in No. 3 Creek, the Silurian series includes sediments which have yielded *Monograptus* and conglomerates with dimpled pebbles. In the southern part of the area, about 1 mile east of Hurst's Hill, the Silurian rocks include sandstones, shales, and conglomerates. They are highly crumpled near the contact with the Hoathian series, and a specimen of *Monograptus* has been found in one of the shale beds.

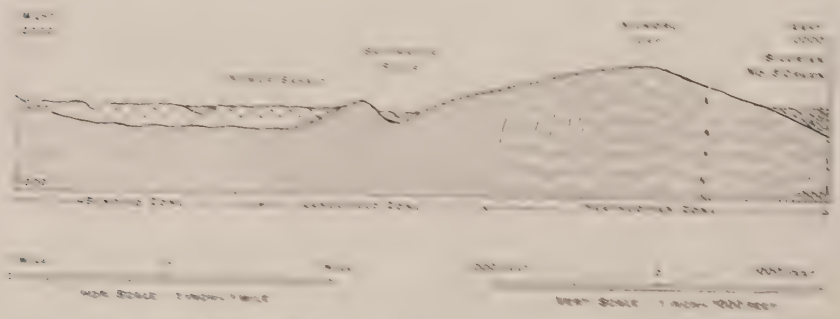
Newer Basalt and Alluvium.

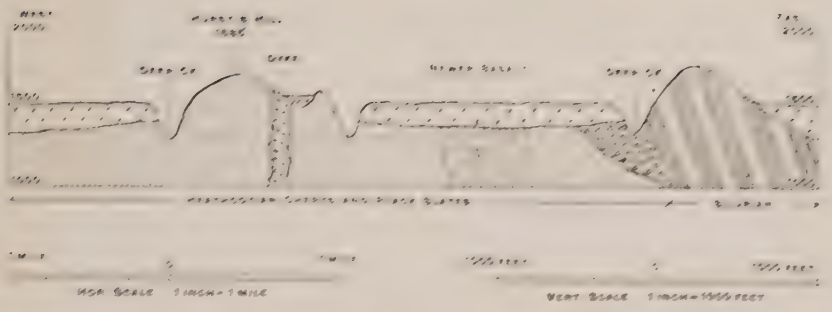
The Newer Basalt is widespread in the western and southern parts of the area, and overlies the outcrops of the Ordovician sediments. Several centres of eruption occur within the area, and the flow from one of these, starting from the south-east of Mt. William, covers up the junction between the Hoathian and the Silurian rocks for many miles in a southerly direction.

Alluvium.—Swampy areas at Kilmore and drainage on the Newer Basalt and many deposits along the creeks constitute alluvial deposits of recent age.

The Relations of the Heathcotian Series to the Silurian and to the Lower Ordovician Rocks.

Relations of the Heathcotian to the Silurian Rocks.—The similarities of succession along the western outcrop of the Silurian series, the presence of Heathcotian types of slates and of Ordovician quartzites among the pebbles and the difference of strike between the two series have unmistakably led the two series into unconformable and that the western portion of the Silurian was buttressed against an elevated land area consisting of Ordovician and of Heathcotian rocks. These relations are suggested in the two sketch geological sections accompanying this paper.





Sketch Geological Section West to East through Hurst's Hill

Relations of the Heathcotian to the Lower Ordovician Rocks.—References to this subject occur in the following papers:—

Gregory, J. W., Proc. Roy. Soc. Vic., Vol. XV. (n.s.), Pt. II., 1903, pp. 161-163.

Skeats, E. W., Proc. Roy. Soc. Vic., Vol. XXI. (n.s.), Pt. I., 1908, pp. 343-344.

Skeats, E. W., Aust. Assoc. Adv. Sc. Brisbane, 1909, pp. 175-177.

David, T. W. E., and Skeats, E. W., Federal Handbook of Australia, 1914, p. 262.

Teale, E. O., Proc. Roy. Soc. Vict., Vol. XXXII. (n.s.), Pt. I., 1919, pp. 54-60.

Teale, E. O., Proc. Roy. Soc. Vict., Vol. XXXII. (n.s.), Pt. II., 1920, pp. 131-133.

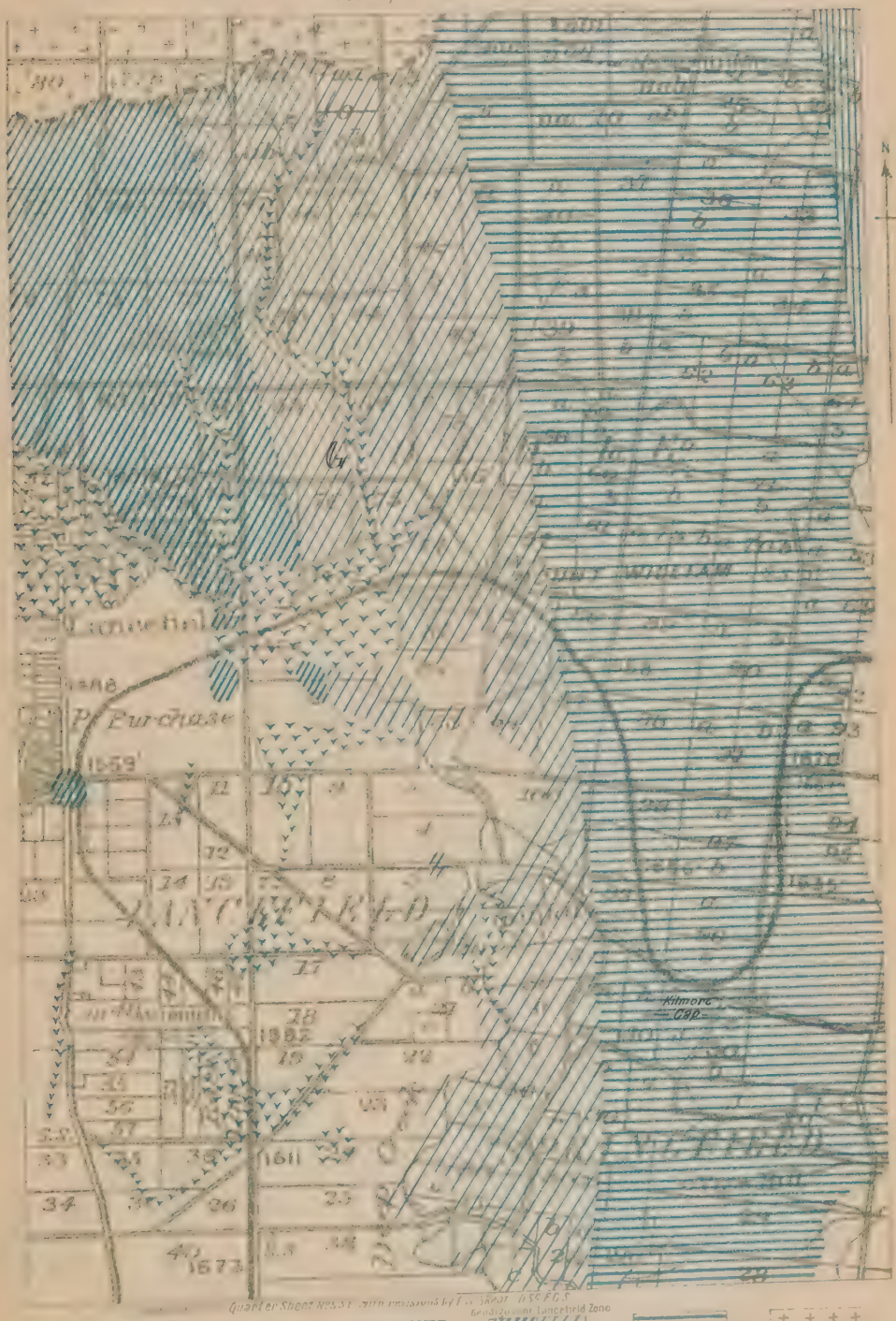
The views expressed by Prof. Gregory were that the Heathcotian was not only of Pre-Ordovician but, as stated in a later communication, one of Pre-Cambrian age; that it formed an elevated land ridge running north and south from Castlemaine to Bacchus through central Victoria; and that in consequence it formed a barrier and determined the easterly limit of the Lower Ordovician sea and also the southerly limit of the Silurian sea. In consequence it was claimed not only that the Silurian series lapped unconformably against a Heathcotian barrier, a view confirmed by later work, but that the Lower Ordovician rocks rested unconformably against the slates and schists of the Heathcotian series. This latter view carried the implication that Lower Ordovician sediments would not be found to the east of this meridional ridge of Heathcotian rocks. The author in earlier papers controverted these views as to the relations of the Lower Ordovician to the Heathcotian rocks and as to the distribution of land and water in the Lower Ordovician period. He pointed out that in the Heathcote district the sediments lying west of the Dyrons fault, while unfossiliferous, have been generally referred to the Lower Ordovician and that they like the Heathcotian rocks have high westerly dips and both areas show a parallelism of strike. In addition, an marginal conglomerate of Lower Ordovician age finds its

Heathcotian ridge such as are found in the marginal Silurian series to the east of the ridge. For these reasons he claimed that the presumably Lower Ordovician sediments of the Heathcote district rested conformably upon the Heathcotian series, and that the latter represented a submarine series of lavas and tuffs interstratified with sediments now mainly cherts. The finding of several well-developed examples of *Protospongia* in the bedded cherts at Heathcote in recent years has substantiated the view of the marine origin of the series. The evidence from the Lancefield area confirms the earlier view as to the marine origin of the Heathcotian series, both cherts and diabases, and the good sections exposed in railway and road cuttings show clearly the conformable upward passage first into the Lancefieldian series and further west into the Bendigo series of the Lower Ordovician.

With regard to the structural relations, the author pointed out that serpentines and cherts, possibly Heathcotian, occur near Casterton in western Victoria ; that Heathcotian types of interbedded diabase and cherts occur at Mt. Stavely, and recur along the north and south ridge through Heathcote and Mt. William ; while more recent work by Teale has demonstrated the presence of another defined outcrop in the Howqua valley, nearly 100 miles east of the Heathcote ridge. It was suggested that Post-Lower Ordovician and Pre-Silurian folding combined with erosion would account for these outcrops of Heathcotian rocks as inliers constituting the axes of big structural anticlinal folds. Holding this view, the author suggested that the Heathcote ridge did not exist in Lower Ordovician times and that the Lower Ordovician rocks might be expected to be found well to the east of that line. Since that publication the views expressed have received confirmation as the result of records of Lower Ordovician fossiliferous rocks in several localities. In the Mornington Peninsula as far back as 1903 Bendigonian graptolites were found by Ferguson, and at a later date *Tetragraptus approximatus* marking Lower Bendigonian and Upper Lancefieldian horizons has been recorded. At Boolarra, south of Morwell, an inlier of Lower Bendigonian or Upper Lancefieldian slates with *Tetragraptus approximatus* has been found by Ferguson. Near Mansfield, at the phosphate beds, *Tetragraptus* and other Lower Ordovician graptolites were found by the author in 1909 ; and in 1919 Teale described from the Howqua area not only a typical suite of Heathcotian diabases and interbedded cherts containing *Protospongia*, but higher up stream slates containing *Tetragraptus* and other Lower Ordovician graptolites were found. The result then of more recent work has been not only to strengthen the views expressed by the author in 1909, but to extend our knowledge of the area of deposition of Lower Ordovician marine sediments for about 100 miles east, of the limit formerly assigned to them.

THE LANCEFIELD-Mt WILLIAM DISTRICT

Scale, 1 Mile to 1 inch


N
Kilmore Gap
Quarter Sheet No. 5 S.E. with revisions by F. A. Secombe, B.Sc., F.G.S.
Geological Survey Lancefield Zone
Alluvium & Newer Pliocene
Basalt
Silurian Sandstones &c
Ordovician Slates, fine grained Sandstones &c
Cherts, silicified slates, diabase &c
(Devonian?)

6. EXCURSION TO YALLOURN.

(*Thursday, 16th August*, 1923.)

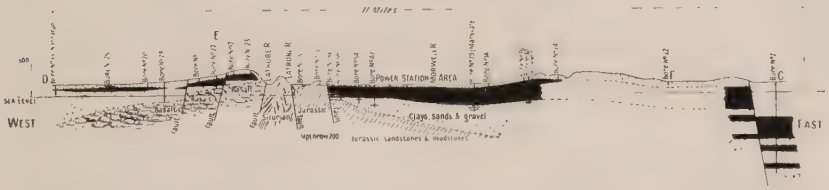
Notes on Geology of Yallourn.

By H. Herman, B.C.E., M.M.E.

The brown coal beds of the Latrobe valley are probably Miocene or a little older. They extend easterly from Yallourn without interruption, except faulting, for more than 20 miles easterly, occupying a known area of perhaps 150 square miles.

The thickness of the coal in one or more seams varies from about 780 feet downwards. The thickest coal so far found is at Morwell township, about 5 miles south-easterly from Yallourn. Adjoining the Yallourn open cut, the thickness varies from about 150 to 250 feet without any parting. Where the steam shovels are operating on about 30 feet of overburden, the coal is about 150 feet thick.

Sands, clays, gravels, and occasionally some cemented sandstone or conglomerate constitutes the beds both underlying and overlying the coal. The power station, in course of erection, is on Jurassic strata, which are the typical series carrying the black coal seams at Wonthaggi and other parts of South Gippsland.



Section illustrating the Geology of the Brown Coal Beds of Yallourn. The Power Station is close to Bore 15.

There is much faulting in the neighbourhood of the open cut. The accompanying section shows the probable relations of the brown coal-bearing strata to the Jurassic, Silurian, and basaltic rocks of the immediate neighbourhood. Geologically and physically, the coal is exceedingly like the younger brown coals of Germany, occupying in the peat to anthracite series a place between the-present day peats and the advanced lignites in the United States and Canada. About 6 miles easterly from the Yallourn cut a bore penetrated the brown coal-bearing measures a depth of 1,358 feet without passing through them.

The immediate uses to which the coal is to be put are power production and briquette-making. The coal with a calorific value of 4,000 to 5,000 B.T.U. per lb. will be burnt raw in the boiler furnaces, both at the briquette factory and power station. The briquettes with a calorific value of about 9,500 B.T.U. are intended principally for domestic and boiler use in Melbourne and other places distant from Yallourn.

SECTION 9.—HYGIENE.

1. EXCURSION TO SERUM INSTITUTE.

(*Tuesday*, 14*th August*, 1923 (*Afternoon*).

The members of the Congress have been asked to visit the Commonwealth Serum Laboratories by Dr. J. H. L. Cumpston, Director-General of Health.

The Laboratories are situated in Royal Park and are within easy access of the University by the Brunswick tram. Delegates coming to the Laboratories by tram will take the Brunswick car in the direction of Brunswick, alight at Ievers-street, and walk through Royal Park Station to the Laboratories—about ten minutes' walk.

The Laboratories are even more easily accessible from the City by means of the electric service on the Coburg line, electric trains leaving Flinders-street and Spencer-street about every 15 minutes for Royal Park station (a journey of about 14 minutes); the Laboratories are then 5 minutes' walk from the station.

The general purposes of the Laboratories are to supply Biological products for use in the Commonwealth and in New Zealand, that is to say, serums, vaccines, tuberculin, endocrinic products (especially Insulin); and also Veterinary products. Furthermore, they undertake diagnostic work for practitioners and Public Health work for various Health authorities.

A section of the Laboratories is devoted to the post-graduate education of medical men who intend to serve in the Country Laboratory Service of the Department.

Visitors are asked to assemble at the Laboratories in the Library at 2.30 p.m. on 14th August. If the Library is not sufficiently large to accommodate the number, visitors will be asked to assemble in the dining hall on the second floor.

2. THE METROPOLITAN SEWAGE FARM AT WERRIBEE.

(*Tuesday*, 21*st August*, 1924.)

About 24 miles south-west from Melbourne, at Werribee, and within easy reach by motor car, lies a huge farm through which the sewage of Melbourne and suburbs is filtered into the sea. This farm is maintained by the Melbourne and Metropolitan Board of Works, which provides the metropolis with its water and sewerage. Through the courtesy of this Board an opportunity has been provided for members of the Pan-Pacific Congress to visit the farm.

The sewage from an area with an estimated population of 739,239 is discharged on the farm, and the volume received per day (1921–1922) amounts to 39,235,506 gallons, or 144.5 acre-feet. This sewage flows through the city mains by gravity to the pumping station at Spotswood, where the solids are strained out, dried, and carted away to be discarded, as they have no manurial value. The sewage is then raised by pumps and taken to the farm, partly

through pipes and partly through open channel. The sewage is then spread on the land. Through this process, an immense tract of bleak plains country, with an average annual rainfall of 18 inches, has been converted into a fertile farm, showing as profit a sum which would otherwise have to be made up by increased rates.

The farm has an area of 13,219 acres, of which 6,884 acres have been specially prepared and are in use for sewage irrigation. The land required for sewage filtration purposes is divided into 20-acre blocks (20 chains by 10 chains), which are graded into bays of about half-an-acre each, and commanded by distributing drains to facilitate rapid flooding. The sewage is distributed by means of main carriers and drains which run parallel north to south through the farm half-a-mile apart, and sub-carriers and drains which branch east and west every 10 chains. The filtered sewage is discharged into the bay by a series of main effluent channels running parallel north and south through the farm.

The farm produces crops for cattle-feeding and provides large areas for grazing purposes. During the past year, 1921–22, 180 acres of lucerne yielded approximately 495 tons of hay, or $2\frac{3}{4}$ tons per acre ; while 174 acres of maize yielded about 60 bushels of grain per acre. The fattening of cattle is an outstanding activity, and in recent years high-grade beef cattle have been bred on a large scale. Sheep are kept chiefly as scavengers to eat weeds and roughage along the drains. In addition to saving much labour they brought in a profit of £367 during the past year. There were 7,536 cattle on hand at the end of the year.

In the year 1921–22 these was a heavy slump in the prices of fat cattle, with the result that a loss occurred in the cattle transactions, and a loss of £4,837 on the total trading transactions of the farm. The three previous years were more normal, however, and brought in trading profits of £34,112, £41,061, and £15,750. After charging £15,758 cost of sewage disposal, and £28,711 interest on total capital cost, the net cost of sewage purification for 1921–22 was £49,306, or 1s. 4d. per person served per annum, and this for an abnormal year in which there were no farm trading profits.

The pedigreed cattle are Shorthorns and Herefords, and many fine specimens of these breeds may be seen. As the farm is debarred from the sale of milk, cattle-breeding has been limited to beef strains.

The employees on the farm number 174. With their families they make up a healthy community of several hundred.

SECTION 11.—ZOOLOGY.

1. VISIT TO NATIONAL MUSEUM.

(*Tuesday Afternoon, 14th August*, 1923.)

Leader.—Prof. Sir W. Baldwin Spencer, D.Sc., F.R.S., etc.

2. EXCURSION TO HEALESVILLE RESERVATION OF THE AUSTRALIAN INSTITUTE OF ANATOMICAL RESEARCH.

(*Saturday, 18th August, and Sunday, 19th August*, 1923.)

The Research Reservation is an up-country adjunct of the Australian Institute of Anatomical Research, which was founded for investigations on the anatomy, physiology, and histology of members of the Australia fauna, more especially in relation to medical science. The object in having the Reservation was to enable our native fauna to be studied under conditions as nearly natural as possible. It occupies an area of 80 acres held on a lease from the Government of Victoria, and is situated at the foot of Mt. Riddell, with the Badger River, a small never-failing stream, running through it. The reservation is surrounded by a T-shaped wire netting fence, 6 feet high, in the construction of which 5 miles of netting were used, and is designed to keep the native game in the enclosure, and foxes, dogs, and "sportsmen" out. The Curator is a well-known Healesville resident, Mr. Harry Logan. In addition to the numerous pens, there is a six-roomed Curator's house, a small lodge for scientists wishing to remain overnight, and a dissecting room and laboratory. Visiting scientists will be able to see most of the varieties of our fauna in the pens, and, loose in the grounds, kangaroos, wallabies, and koalas (native bears). A path runs along the stream from one end of the reservation to the other, and visitors will find beautiful spots for photographing, and will see many magnificent specimens of our native trees. The reservation is the apex of an isolated triangular area of 500 acres, which is bisected by the River Badger, and there is little doubt that in the near future the whole of this area will be permanently reserved as a sanctuary for native game by the Government of Victoria.

3. VISIT TO ZOOLOGICAL GARDENS.

(*Tuesday Afternoon, 21st August*, 1923.)

Leader.—Mr. W. H. D. Le Souëf, C.M.Z.S.

By Authority: Albert J. Mullett, Government Printer, Melbourne.